ENGINEERING NEWS

THE world has never before seen such stops as have been made this week in the Burlington brake tests. Some allowances are to be made for the apparent maximum brake efficiency of 18 *to* 20 *per cent.* in some stops, as noted elsewhere, but after all allowances are made, a working efficiency on the longest trains of 10 to 14 per cent. has been clearly shown which amounts to stopping a train on a level having brakes applied to its entire weight (as passenger trains practically have) in the following distances:

MILES PER HOUR.				
20	30	40	50	60
142 to 101 ft.	319.5 to 228 ft.	568 to 406 ft.	887.5 to 634 ft.	1278 to 912 ft.

This is a truly marvelous advance over the record of a year ago, and as the very highest which could be hoped for by the most elaborate apparatus would be some 20 per cent. it leaves little room for further advance, with probably considerable room for advance in holding in practice the point reached in tests. All the competitors but the Carpenter, Westinghouse and Eames failed to go through the tests and were withdrawn. The Carpenter certainly made a marvelously fine record even without considering that it was its first appearance in its present form on any stage, and its first appearance in this country in any form. The Westinghouse record is a good second, and the Eames not so good a third, but even the poorest record is so vast an advance on hand brakes that the introduction of power brakes for freight trains cannot be long delayed. The American was unable to get its new air brake ready, and did not enter the tests.

IN connection with the Harlem Ship canal project which now seems to be an affair of the near future, we regret the possible removal of the present High Bridge in the interest of navigation. While the completion of the New Croton Aqueduct will make this structure practically of but little value as a carrier of water, we still hope that it will be allowed to remain as a monument to the good taste and excellent workmanship of a past generation of engineers and contractors. Architecturally it is the finest piece of engineering masonry in this vicinity, and we doubt much if anything can be found to surpass it in general good effect in this country.

THE ill-starred Mexican National Railway Company has ceased to exist, and the Mexican National Rail*road* Company succeeds to all its property and franchises for a consideration of $9,722,000, bid by Mr. ECKSTEIN NORTON, President of the Louisville & Nashville. The completion of the gap between Saltillo and the northerly end of the southern line, will begin at once, it is stated, with the expectation of closing the gap within the present calender year. There are some 300 miles to build, but all but a few miles of it is very light work. As the new line will be 400 or 500 miles shorter to Chicago and New York than the Mexican Central, it will be likely to take most of the international passenger travel, despite its unfortunate narrow gauge, which the new company will be wise to change at once, and, we suspect, will do so. The Pacific branch, now constructed from Acambaro to Patzcuaro, remains in the hands of the Mexican National Construction Co. The purchase is supposed to amount practically to an extension of the Louisville & Nashville system to the city of Mexico.

THE early date of May 28 for the proposed freight coupler tests, as announced in our issue of May 14, has proved too early, as was but natural, and the tests will now be made early in June. The physical tests will be made at the Watervliet Arsenal. The committee seem to have determined to make the tests private, so far as possible, so much so that only one representative of each competing device will be allowed to participate in the preliminary trials and he only while his own device is being tested on the track laid under the supervision of the committee. While there are certain obvious advantages in this course, we fear that it will be found that its disadvantages far outweigh them, and that the committee will have reason to regret their decision.

LAST Tuesday, May 24, was the fourth anniversary of the opening of the Brooklyn Bridge. In these four years 15,963,919 passengers have crossed the promenade and 64,111,556 have used the cars. The total receipts have been $2,435,787.23. The present month will be the one of greatest traffic, the number of passengers reaching 2,600,000: last March came next with 2,433,069.

MAYOR HEWITT has been talking very plain English this week to the street railway magnates of our city. The sanding of the tracks was the chief cause of the trouble, but Mr. HEWITT proposes a general reform in this and other directions judging from his remarks. The railway companies argued that they used sand on their tracks out of mercy to their horses, and further that they used the best rail and track generally. The Mayor suggested that it would be more merciful to employ two horses where they now used one, and as to the rail he knew all about it, as it was devised by himself as a manufacturer, at the request of the companies, with special reference to its non-use by the public. He further thought that the eyes of pedestrians were of quite as much account as the increased hauling capacity of a horse. We trust that the Mayor will keep up a vigorous campaign, for the street railways of New York stand in need of reform. The center-bearing rail referred to is a nuisance that cannot be too soon abated, and the profits of the companies would warrant a very much increased expenditure upon their roadway generally in making it a more substantial structure. The proper character of paving between the tracks and its maintenance in constant good condition would practically do away with the necessity for sanding, and answer a better purpose than the suggested roughening of the present paving by chiseling, as the latter is imperfectly done at the best.

WE have been waiting with considerable impatience for some full and impartial account of the opening of the American Exhibition in London, and a description of its chief exhibits. So far one exhibit only has been especially noted, but it is one far outshining all the rest, *i. e.* the Wild West entertainment. *Engineering* after highly commending the energy of the managers of the Exhibition and the many general attractions of the grounds concludes by saying that all else are but "side shows" to this unique exhibit. The *Iron and Coal Trade Review* says that the Exhibition is disappointing to those who expected to see "a display of the ingenuity of the Anglo-Saxon race across the Atlantic," and says further that the Americans have apparently done little in the way of exhibiting their inventions and productions. But as many exhibits are evidently not yet displayed, we trust that later reports may somewhat modify this verdict. The English press however seem in unite to voting it a most thorough success as a place of amusement and sight-seeing.

WHEN the Duluth, South Shore & Atlantic R. R. was first projected, it was proposed to build branches into the country north and west of Duluth and arrangements were made with the holders of the franchise of the Duluth & Winnipeg Co. to build that line and acquire its valuable land grant. To this move President HILL, of the St. Paul, Minneapolis & Manitoba Ry., decidedly objected, and the result of negotiations, which have been in progress for some time, is a mutual alliance of much benefit to both parties. The South Shore Co. will build only to the Minnesota State line and refrain from entering Duluth or building into the Manitoba's territory. In return for this, the latter company is to make the South Shore its eastern connection, and with nearly 3,000 miles of lines through the farming, grazing and mining regions of the northwest, will be able to give to it an enormous volume of traffic. The South Shore Co. has also made favorable arrangements with the Canadian Pacific and the Vanderbilt lines to be its outlets to the Atlantic seaboard; and with so desirable connections at either end and a profitable local traffic from the mining regions of the Michigan peninsula, can well afford to leave the Manitoba to contest with other rivals for the traffic of Minnesota wheat fields.

THE proposed Quaker Bridge Dam is to have an American rival in the dam to be built for the Spring Valley Water-Works, of San Francisco, Cal. The plans for this structure are said to be about completed. It will be located at the upper end of the San Mateo cañon, some four miles from San Mateo, where the bed of the cañon is about 150 ft. above sea-level, and solid rock is found to base it upon. According to the San Francisco *Call*, the dam will have a vertical height of 170 ft., with a base 175 ft. wide and a top width of 20 ft., and will be 700 ft. long on top. It will be curved in plan with a versed sine of 80 ft. The material to be used in construction is concrete "of a new sort," and including the foundations, its contents are estimated at 160,000 cu. yds. The reservoir thus formed will contain 32,000,000,000 galls. of water, and be eight miles in length by 150 ft. deep at the lowest point. The water will be started on its way to the city through a rock tunnel. Mr. SCHUSSLER is the chief engineer, and work has actually been commenced at the site of the dam. The estimated cost is $1,500,000.

THE floods are subsiding in New England, and the rivers will probably return to their normal condition without doing any further damage. No accidents have been reported.

THE most serious railroad accident of the week occured May 22 and was due to a misplaced switch on the Baltimore & Ohio Railroad at Bayview Junction, near Baltimore, Md. A yard engine ran on to a wrong siding at a switch which had been left open, and collided with two telegraph camp cars, telescoping them. Of four men on the platforms between the cars, one was killed and three seriously injured. There was no regular switchman, the conductors and the yard clerk doing the switching.

IMMIGRATION for the *nine* months ending March 3, was 45 per cent. greater than last year, for the *three* months, 57 per cent. greater than last year, for the *month*, 73 per cent. greater than last year. The rate of last year must be considerably more than doubled before the high water mark of 1882 is reached, but just at present the weekly rate is higher than was ever known, 9,063 having arrived on twelve steamers in one day recently, the largest previous record (May 19, 1873), having been 7,853. Judging from past experience, at least two years of heavy immigration are before us, which means two years of high water prosperity—but the crash comes deuced suddenly, and no man knoweth the day nor the hour, except that it always comes a little sooner than expected—and catches engineers on the hip who have been spending their money as fast as they earned it.

THE Australian Intercolonial Railway, between Melbourne and Adelaide, a distance of 508 miles, has recently been opened for traffic. An express train ran the entire distance in eighteen and a half hours. From Melbourne to Sydney the distance by rail is 553 miles, and from Sydney to Brisbane, a line now in course of construction, is 500 miles additional. When this last link is completed the chief colonies of Australia will accordingly have an internal line over 1,500 miles in length, available for the massing of troops in the event of their coasts being attacked. The island is nearly as large as the United States, but most of its interior is barren and worthless for lack of water. There is still room, however, for a vast development, in which Americans will no doubt take a hand.

A COMMITTEE of the New York Senate makes an interesting report in regard to the ventilation of the capitol; that the entire air supply is sucked in through a vertical tunnel 33 by 23 ft. in section, and 120 ft. high, on which open eight rooms filled with water closets and several sewer ventilators, so that the air supply sucks in these exhalations and sends them again through the building. The remedy proposed is $40,000, to get ready to begin to do something else, we suppose. It seems strange that the obvious impropriety of taking the supply of "fresh air" from such a dangerous source, with all outdoors to draw from, should not have occurred to the architects in advance.

The Electrical Railways of the World.

[Presented by P. C. MARTIN and JOSEPH WETZLER, of the *Electrical World* at the last Annual Meeting of the American Institute of Electrical Engineers.]

ELECTRIC RAILWAYS IN EUROPE, APRIL, 1887.

PLACE.	Length.	Motors and motor cars.	No. of passengers.	Freight.	Total expenses of operation.	Car miles run yearly.	System of conductors.	Prime power.
Lichterfelde-Berlin, 1881.	1½ miles.	2	100,000 yearly.				All rail	Steam engine.
Brighton, 1883	1 mile (single track).	2	1,000,000 total.		1.92 pence per car mile.	46,950	All rail	Gas engine.
Moedling-Hinterbruehl, 1884	2.8 miles (single track and sidings.)	12	340,000 yearly.		3.42 pence per car mile.	91,002	Overhead slotted tubes	Steam engine.
Frankfort-Offenbach, 1884	4.1 miles (double track.)	14	990,000 yearly.		3.83 pence per car mile.	292,269	Overhead slotted tubes	Steam engine.
Zankerode (mine) 1882	790 yards (double track.)	1 loco., 16 wagons.		300 tons daily.	.77 penny per ton	660 wag'ns daily	Overhead inverted L-rails	Steam engine.
Hohenzollern (mine) 1884	820 yards (double track).	1 loco., 16 wagons.		300 tons daily.	.5 penny per ton	600 wag'ns daily	" " "	Steam engine.
Portrush, 1883	6 miles (single track)	4	Over 100,000 up to 1885.		2½ pence per car mile		Third rail	Water power.
Bessspool, 1884	3 miles (single track)	8	300,000 yearly.	30,000 tons yearly.	4 p'nce p'r train per mile	60,000 tra'n mls. ye'rly	Third rail	Water power.
Blackpool, 1885	2 miles (single and double)	10	Over 1,000,000 total.		Less than 4 p'nce per car mile		Conduit	Steam engine.
Brussels, 1887		5					Operat'd by storage batteries	
Hamburg, 1886		2					Operat'd by storage batteries.	

NEW ROADS.—A special charter has been granted by the Austrian Government for a road in the Austrian Alps to cost about $350,000, and to be 15 miles in length.

A road is being built in the great salt mines at Stassfurt, Germany.

The North Metropolitan Tramway Company, in London, has several motors now ready for use with storage batteries, on its line, awaiting powers from Parliament.

ELECTRIC RAILWAYS IN AMERICA, APRIL, 1887.

PLACE.	Length.	Motors and motor cars.	No. of passengers.	Freight.	Expense of operation.	Car miles run.	System of conductors.	Prime power.
*Baltimore, Md., 1885	2 miles (single tr'ck with turn outs)	6.	260,000 yearly.		$4 per car per day	Each motor runs 73 miles daily	Third rail and overhead wire	Steam engine.
*Los Angeles, Cal., 1887	3 miles, single and double	8.	200,000 yearly.				Single and double overhead wire	Steam engine.
*Port Huron Mich., 1885-6	4 miles, single tr'ck	8.	275,000 yearly.				Single overhead conduc'or	Steam engine.
*Windsor, Can., 1885.	Nearly 2 miles, single track	2.	200,000 yearly.		$4 p'r day for power	64 miles each car per day	Single overhead conduc'or	Steam power from electric light station.
*Highland Park, Detroit, Mich., 1886	3½ mls., single tr'ck	2.	200,000 yearly.		80 cents per day for fuel.	Each car runs 13 hours daily; capacity, 30 passengers; speed, 15 miles an hour	Sunken central rail	Steam engine.
*Dix Road, Detroit, Mich., 1886	1¼ mls., single tr'ck	4.	300,000 yearly.			The trains run from 6 A. M. to 11 P. M.	Double overhead conductor.	Steam engine.
*Appleton, Wis., 1886.	4½ miles, single track and double	8.	400,000 yearly.		For power, wages of one man, as they own their own water power.	17 hours daily	Double overhead wire.	Turbine water wheels.
*Scranton, Pa., 1886	3¼ miles, single track, four st'd'gs	3.	300,000 yearly.		$9 per day for power, but are putting in their own engine.	Each cars runs 85 miles per day	Overhead wire.	Steam power from electric light station.
Denver, Col., 1886	3½ miles, single and double	7.	500,000 yearly.		$1.50 per day for fuel		Conduit for series system.	Steam engine.
Montgomery, Ala., 1885-86.	11 miles, single and double	18.	Th's ran 2 cars one year. Have just start'd other cars. (1,000,000 y'ry.)		50 per cent. less than horse and mule traction — General Manager's report		Overhead conductor.	Steam engine.
†Kansas City								
Orange, N. J., 1887	⅝ mile built	1.					Overhead conductor	Steam engine.
Boston, Mass. (sugar refinery), 1887	Short track within the works	1 locomotive 10 cars		The cars in constant use all day; the loads averaging 10 tons per trip and each round trip averaging 5 minu's			Overhead conductor.	Operated from the lighting dynamo.

*Extending line or increasing rolling stock. †No specific details received, line not being yet in regular operation.

NEW ROADS.—Electric railways are now in course of construction, or under contract, at Pittsburg (3 roads); Los Angeles; Binghamton, N. Y., 4½ miles, 8 motor cars; Lima, O., 8 miles, 6 cars; San Diego, Cal., 9 miles, four 40 h. p. motor cars; Ansonia, Conn., 3½ miles (water power); New York City (for Fulton street); St. Joseph, Mo., 20 cars; Mansfield, O.; Ithaca, N. Y.; Harrisburg, Pa.; Woonsocket, R. I.

Companies have been formed or steps taken to build and operate electric roads at Flushing, L. I. (2); Lincoln, Neb.; Brookline, Mass. (2); East Cambridge, Mass.; Newton, Mass.; Boston, Mass.; Asbury Park, N. J.; Pelham Park, N. Y.; New Brunswick, N. J.; Plainfield, N. J.; Bayonne, N. J.; Worcester, Mass.; Scranton, Pa.; Carbondale, Pa.; Philadelphia, Pa.; Reading Pa.; Banger, Me.; Biddeford, Me.; Westfield, Mass.; Chicopee, Mass.; Muncie, Ind.; Gratiot, Mich.; Tiffin, O.; Cincinnati, O.; Brooklyn, N. Y.; Coney Island, N. Y.; Rockaway, N. Y.; Winston, N. C.; Jacksonville, Fla.; Pensacola, Fla.; Birmingham, Ala.; Selma, Ala.; Atlanta, Ga.; Fort Smith, Ark.; Wichita, Kan.; San Francisco; San Jose, Cal.; Newton, Kan.

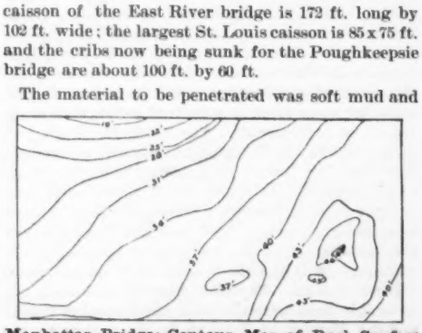
To accompany paper on "A Few Comparative Statistics of Electric Railways," by T. C. MARTIN, American Institute of Electrical Engineers, New York Meeting, May 18, 1887.

The Caisson for Pier II. of the Manhattan Bridge

The bridge now under construction by the City of New York over the Harlem river, a short distance above the High Bridge, has already been described in its general features in our issue of April 10, 1886, excepting that the approaches have been very materially changed since then and the structural details most decidedly improved, as we expect to show later.

The present purpose is to illustrate the caisson upon which Pier II. is founded on the eastern bank of the river. In its general design this caisson differs little from the usual practice; but its dimensions and the nature of the material penetrated make it well worthy of record. From out to out of sheeting this caisson measures 104.8 ft. in length and 54.4 ft. in width, and it is 13.3 ft. high from bottom of shoe to the top of the deck, the sides battering one foot all around in this height. In general dimensions this caisson takes about the third rank among the large American bridge caissons. The New York caisson of the East River bridge is 172 ft. long by 102 ft. wide; the largest St. Louis caisson is 85 x 75 ft. and the cribs now being sunk for the Poughkeepsie bridge are about 100 ft. by 60 ft.

The material to be penetrated was soft mud and



Manhattan Bridge; Contour Map of Rock Surface under Pier II.

(Figures show distances in feet below mean high water.)

gravel with heavy boulders in the bottom stratum; but the rock underlying this deposit and upon which the caisson had to find ample bearing was very irregular in its character. As shown in the accompanying diagram, which gives by contour lines the depth of the rock in feet below mean high water, this rock pitched rapidly downwards towards the southeast from 17½ ft. to 49 ft. below this datum, and with much irregularity in the contours. As now completed the oak shoe of this caisson stops at a point 40⅝ ft. below mean high tide the comparatively small area not resting directly upon the rock being securely underpinned by concrete extending to the rock surface.

The caisson is built entirely of yellow pine squared timber, 12 x 12-in. in dimension, saving only the 3 x 9-in. oak shoe-plank. The sides of the working chamber were built up as shown, with a thickness of 3 ft. and a height of 6.9 ft. from shoe to ceiling of the working chamber. These timbers were well fastened by a multitude of drift bolts; the walls of the working chambers and the first roof-course were poured with hot tar as they were built up. The inside of the working chamber was made practically air-tight by lining it throughout first

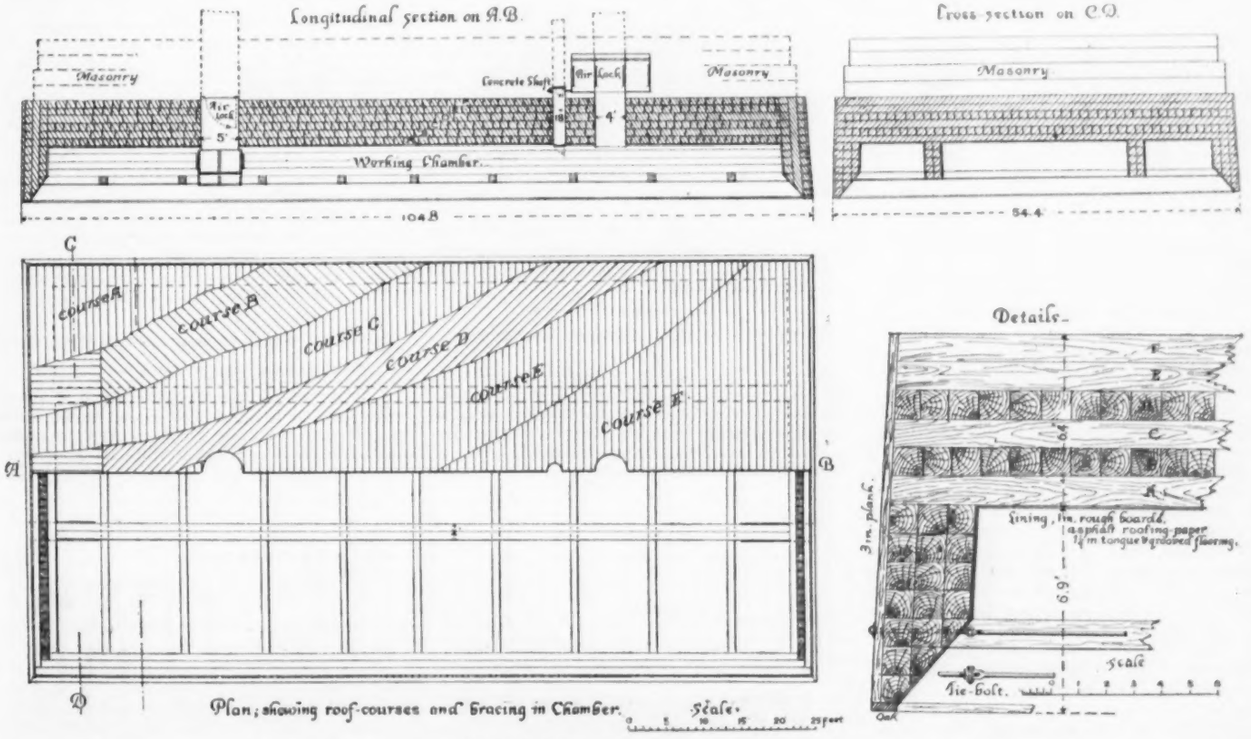
with 1-inch of rough boards, then a layer of asphalt paper and finally with a covering of 1¼-in., tongue and grooved boards with the joints whiteleaded.

The caisson was braced longitudinally with two walls of squared timbers, 2 ft. thick, with openings left for communication between the chambers; these walls were lined like roof and sides of the working-chamber.* The ends of these partitions were tied to the end walls of the working chamber by two bolts passing through the walls and flattened out on the inside to 1 x 4-in. and spiked fast to the timbers. The cross tie in the caisson was made with nine 12 x 12-in. timbers each having a tie-bolt passing through the walls and secured as shown in the "details."

The roof-courses were arranged as shown on the plan; and, excepting the first one, were all grouted with pure Rosendale cement as they were laid. The arrangement of the ends of the diagonal courses *B* and *D* is a departure from the usual practice, and was adopted being soon abandoned however on account of the gases generated acting badly upon the men in this close working chamber; the rackarock proved harmless and its use was attended with little inconvenience.

After the point was reached at which it was decided to stop the caisson, the rock surface was carefully cleaned of all debris; the small area lower than the shoe well packed with concrete and the entire working chamber and the shafts finally filled with the same. This concrete was made of Portland cement mortar, with one part cement to two of sand; the concrete was made outside and delivered through the 18 in. concrete shaft shown on the elevation.

Work was commenced upon the caisson framing in Sept. 1886; on Nov. 15 the caisson began to sink, and on April 17, 1887 the working chamber was "sealed" and the compressed air dispensed with; it took about two weeks to complete the filling of the



Caisson of Pier II; Manhattan Bridge.

for the purpose of giving a better bond at these points; it will be noticed that there are no longitudinal through courses in this roof. The top course of all was secured at the ends by 3 x ⅛ in. iron straps 3 ft. long spiked with 10 in. spikes.

The air-locks and concrete shafts were of the ordinary type; the lock on the 4 ft. shaft having been originally constructed for the repairs to the Chestnut St. bridge, in Philadelphia (see ENGINEERING NEWS, Jan. 3, 1885, for details), and simply adapted to this work by putting in a temporary wooden diaphragm when it became necessary to lift the lock as the masonry portion of the pier was built. The 5 ft. air-lock was provided with a rectangular extension, 5½ ft. square by 4 ft. 9 in. high, inside the working chamber. This extension was made of ⅛ in. plate reinforced by 4 x 4 in. angles and tees, and was bolted together with some 600 bolts instead of being riveted, as all its parts had to be passed down and taken out through the circular shaft above. For convenience in handling the material, which was removed in iron buckets, this lower lock had two doors, each 24 x 42 in., opening outward; a third door opened downward near the foot of the 5 ft. shaft as shown.

The rock was removed by drilling and blasting; and for the first time in the history of caisson work, power drills (Rand's Little Giant, No. 3,) driven by compressed air was used. The blasting was done with dynamite and rackarock; the use of the first working chamber and the shafts. About 1,500 cu. yds. of rock and about 6,700 cu. yds. of earth and boulders were removed; the concrete in the chamber amounted to 1,360 cu. yds., and there were 520,000 ft. B. M. of timber in the caisson and about 50,000 lbs. of iron work. The contractors for sinking the caisson were Messrs. ANDERSON & BARR, acting with Mr. MYLES TIERNAY, the general contractor for the work. Mr. A. NOBLE was the Engineer-in-Charge, with Mr. WM. R. HUTTON, Chief Engineer for the Commission.

*The "cross-section C. D." does not space these walls properly; they are correct the plan.

Simpson's Timber Dry-Docks.*

BY LIEUT. COMDR. C. H STOCKTON, U. S. N.

Congress during its last session having appropriated a sum of $1,100,000 for the construction of two timber dry-docks at such navy yards as the Secretary of the Navy may designate, it has been suggested that a few remarks upon timber dry-docks, of a descriptive and general nature, may be of interest to the members of the Institute and to the readers of its Proceedings.

The only excavated timber dry-or graving-docks that have been built upon our seacoast have been those known as Simpson's improved dry-docks. These have been duly inspected and examined by at least three boards of officers, composed either mainly or entirely of civil engineers and naval constructors, and approved and strongly recommended by them. By this system of docks (excavated docks) the best type of docking appliance can be constructed with rapidity, comparative cheapness, and of sufficient strength and durability.

The first dock on this plan was built in East Boston, Mass., in September, 1853, and opened for use in 1854, over thirty-two years ago. This dock is in use now, though it has, of course, undergone repairs, some extensive in their nature, one being to deepen it 5 ft. Two other docks of a larger size were built in the same place in 1855 and 1864. Since the completion of these docks others upon the same plan, with improvements from time to time, have been constructed by Simpson & Sons at Portland, Me., in 1866; in the Erie Basin, Brooklyn, N. Y.; at Cramp's shipbuilding yards, Philadelphia, Pa., in 1875; at Locust Point, Baltimore, Md., in 1880; at Harlan & Hollingsworth's shipyard, Wilmington, Del.; and finally, at St. John's, Newfoundland, the largest and most recent of all was finished in 1884. It is also stated that a dock of 600 ft. in length is to be built at Newport News, Va., for the railroad company having a terminus at that point.

The largest dry-dock on this continent is the timber dry-dock built by the Simpsons at St. John's, Newfoundland, for the Colonial Government. It is one that will accommodate any merchant vessel now afloat except the *Great Eastern*. Its dimensions are: Greatest length on coping (head to outer gate-sill), 610 ft 10 in.; greatest width of body on coping, 132 ft. 6 in.; least width of entrance on coping, 84 ft. 9 in.; length on keel-blocking, 563 ft, and greatest draught of water over sill, 25 ft. This dock is similar in shape and construction, in general details, to the other wooden graving-docks of later construction in the United States, and a description of its construction will answer for all.

A coffer-dam was first built outside the proposed work; the excavation was then made after the enclosed site (which was only partially bare at low water) had been pumped dry. The foundation of the dock consists of wooden (spruce) piles, excepting the floor in this particular dock, which rests upon a bed of Portland cement concrete varying from 2½ to 6 ft. in thickness, which in turn rests upon a compact, slaty gravel immediately overlying the bed-rock. Iron tubes were inserted in the gravel along the floor in a vertical position on each side near the axis of the dock and built in the concrete, with their

*From the Proceedings of the U. S. Naval Institute, Annapolis, Md., Vol. XIII, No. 41.

upper ends left exposed above the surface, in order to drain any water that should happen to be in the substratum. Longitudinal timbers of yellow pine about 3 ft. apart were imbedded in the concrete floor foundation and anchored to it by iron bars and bolts. Upon these were laid floor timbers, which are covered in turn by spruce planking to form the working floor. Keel-blocks and sliding bilge-blocks are secured to the floor timbers. Provision was made also for open drains on each side of the keelway under the floor timbers leading to the pump-well at the lower end.

The sides and head of the dock are built on a slope of 54° outward from the vertical. Six rows of piles were driven around the sides and head. Upon these piles are supported inclined heavy brace timbers of yellow pine running from the bottom of the dock to the top, and abutting upon the floor timbers at the lower end. These timbers form the skeleton, as it were, of the dock. At the upper ends these brace timbers are secured to a system of cross-caps or stringers 2 ft. beneath the surface, extending back 30 ft. from the coping, and supported by six rows of piles, to which the caps are firmly secured. This prevents spreading. Diagonal timbers are also introduced to tie these two systems of braces, cross-caps, and piles together. The altars or steps of the dock are sawn out of square timber, a diagonal cut making two altars, the cut side being secured to the inclined brace timbers forming the skeleton of the dock; these altars when thus bolted forming a broad stair or treadway the entire length of the docks on both sides, by which the floor of the dock is readily reached from any point on the coping. The space behind the altars, as the sides are built up, is carefully filled in with clay from the excavation, and the filling well compacted by ramming. Around the entire dock and immediately outside of the outer row of piles supporting the cross-cap timbers a line of 5-in. tongued and grooved spruce sheet piling is driven to exclude the passage of tide-water.

The gate sills are of oak, the entrance being of timber sides sloping about 30° the sides and floor of the entrance being built of solid yellow pine timber in two thicknesses, laid to break joints and filled in behind and underneath with concrete. To the outside faces of the sill are secured rubber gaskets, by means of which the gate joint is made water-tight. No groove is necessary for the iron caisson or floating gate, which is of the usual type, it bearing directly against the sill and solid timber of the abutment, being kept in place by the pressure of the water outside, and the joints water-tight by the rubber gasket.

The dock is filled by eight sluice-gates in the caisson, controlled by suitable valves and emptied in the usual way by steam pumps.

This dock, the largest in America, was constructed and opened for use within nineteen months from the date of commencement. Its cost was $550,000. It is but fair to state that the site was a favorable one for excavation, and that special privileges for importing machinery, etc., free of duty were granted to the contractors.

The Erie basin dry-docks, two in number, one of them the largest on the Atlantic coast of the United States, have some points of difference from the St. John's dock. The principal point of difference is that the sides from high-water level to the top of coping are built of concrete in a monolithic form, faced with a patent artificial stone; this includes the five upper altars. This space is that most exposed to decay, and which first requires repair.

To show the rapidity with which this dock may be constructed, the dock built for the Cramps at Philadelphia may be instanced. This is 450 ft. in length over all, cost $300,000, and was built in nine months.

The granite and concrete dry-dock at the Navy Yard, Mare Island, has cost to date, in round numbers, $2,500,000, and has been in course of construction for twelve years. It is now in condition for use, but it is estimated that it will take $150,000 in money and one year in time to finish the facing and the surroundings. It is but just to say that irregular appropriations and day's work are, to some extent, responsible for this, but those obstacles and increased expenditures are just such ones as will be likely to be met with again in a similar case.

For this sum of money three timber dry-docks of the same size could be built by contract in two years, the timber dry-docks having all the advantages of stone excavated docks excepting permanence, and with the following points of superiority confidently claimed:

1st. That they are dryer and consequently more comfortable and healthy for the workmen.

2d. That wooden docks are cooler in summer and warmer in winter than those of stone.

3d. That the facilities afforded workmen by the low and narrow altars are superior to those of existing stone docks, and that the form of the altars avoids all cutting of shores.

4th. That the annual cost of repairs is less than for a stone dock in a northern climate.

5th. That even if the timber face of the dock should decay and require renewal every twenty years, the interest on the saving in first cost would be much more than sufficient to meet this contingency.

6th. That a wooden dock by contract can be built at a cost of one-half to one-third that of a stone structure of similar size.

As an example of the cost of repairs, the Boston dry-docks have been quoted before; and as improvements have been made in the construction of these docks, it may be fair to state that the largest and last built, No. 1, in 1864, was reported in 1886 by its owners to have cost but $5,000 for repairs since its completion. I may add that there is no danger of the teredo injuring the dock inside, as all sea-worms require a constant supply of salt water to keep them alive, and the outside entrance-walls should be made of stone or concrete. As an extreme case of the repairs to a stone dry-dock, I will quote the case of the New York dock, which will be closed for several months and have repairs made to it at an expenditure of $100,000.

The Proposed Boston Street Car Tunnels.

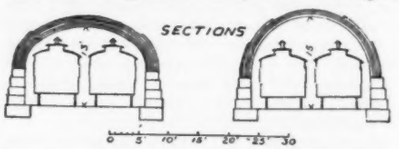
The West End Land Co., of Boston, is making an effort to secure permisssion to invade the sacred precincts of Boston Common in the manner shown in accompanying illustrations. As to the responsibility of that company, and the comparative propriety of granting the privileges desired to them or to some others, we know nothing, but that the project is intrinsically a reasonable and meritorious one we take to be clear, and we understand the chances to be good that either this project or something like it will go through very shortly.

The petition is to tunnel under the Boston Common, laying in all three tunnels, namely; *A*, from Park Square to Merrimac street, a profile of which is shown; *B* from the corner of Beacon and Charles streets to Hamilton place, opposite Park street, and *C*, from Park square to Park Street Church, making its exit in Hamilton place.

The idea of so doing is to avoid three things, and accomplish what the city government has tried in vain to do ever since horse cars were run in the public streets, that is to avoid blockades on Washington and Tremont streets, by running part of the cars through the tunnels; to give a more rapid means of transit between the suburbs and the Back bay district and the business portion of the city, and to avoid laying car tracks on Beacon Hill, as well as to save the Common and malls from being taken as a location for car tracks. The tunnels proposed are of two sizes, both 20 ft. in width, but one, the deep tunnel, as it is called, being 15 ft. high, and the other, being the tunnel which will be used where the headway is small, 13 ft. in height.

Each tunnel will have a double track, and as the grades of the tunnel follow the general surface grade, it is thought that the object of a more rapid and easy means of transportation will be secured.

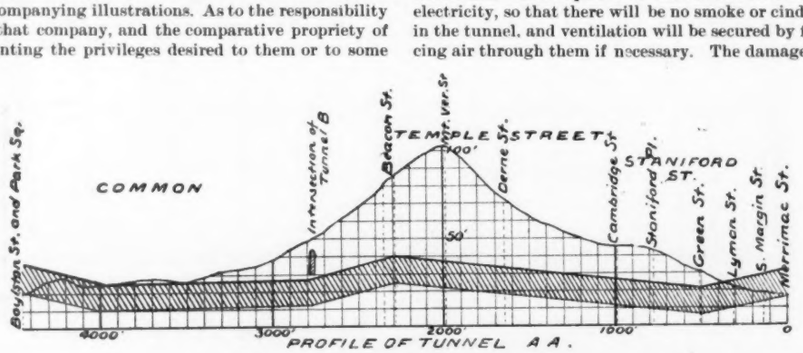
The rails through the tunnels, as well as along the whole route of the West End Railway Company are intended to be the "flat Liverpool" rail, or an American improvement of the same, being a flat rail lying even with the surface and having a groove or cut in the centre, into which the flange of the car wheel fits. It is hoped that the car can be run by electricity, so that there will be no smoke or cinders in the tunnel, and ventilation will be secured by forcing air through them if necessary. The damage to trees has seemed to be the principal objection raised by persons opposed to the scheme of tunneling, but it is claimed that few trees will be damaged which are not already very old.



Sections of Tunnel at opening and Highest Point.

[Outline Map, Showing the General Location of the Proposed Tunnels.]

The Proposed Boston Street Car Tunnels.



Profile of Proposed Boston Street Car Tunnel.
[From Park Square to Merrimac and Causeway Streets, marked A on Map.]

All of the tunnels running under Beacon hill meet at the junction of Beacon, Park and Mt. Vernon streets. From that point they diverge in several directions, running to distant parts of the city. The tunnel from Beacon and Charles streets, running to Hamilton place, enters the ground about 340 ft. east of Charles street. Here, as in the other cases, the 13x20 ft. tunnel is to be used, until a sufficient depth is reached, when the height of the tunnel is raised to 15 ft. Following the grade of the hill, but yet deep enough to avoid all obstructions, tree roots and all, the tunnel runs under the Common to Hamilton place, where the point of exit is nearly on a level with the floor of the basement of Bumstead Hall, from which point Washington street is easily gained by passengers.

The foundations of the tunnels will be as follows: Where the roads enter the ground, and the height of the tunnel is 13 ft. it will be built upon a stone foot wall, 6 ft. high, on top of which the brick work will be laid. In the 15-ft. portions of the tunnels, where they are completely under ground, a 5 ft. stone foundation will be used, and the brick walls will be thinner by two layers of bricks. The

work of excavation will not prove hard, if the supposition is correct that the greater part of the earth to be tunnelled is composed of "Boston hard pan." As near as can be estimated, the cost of construction will be about $50 per ft. where the tunnel is laid near the surface, but where the depth is greatest, as from the middle of Temple street, to a point near the large foundation on the Common, the cost of excavation and construction will be about $100 per ft. The flat tunnel, or 13-ft. one, can, if necessary, be used throughout the entire length, but the cost is greater, there being more bricks used in construction Boston is particularly unfortunate in the time taken by its horse-cars in making the circuit of the center of the town, and this project would certainly add greatly to convenience of transit.

The Lehigh Valley Creosoting Works, Perth Amboy, N. J.

The Cresoting Works of the Lehigh Valley railroad Co. at Perth Amboy, N. J., built last year, and at present operated by the Lehigh Valley Creosoting Co., are of interest to all parties concerned in timber constructions, as emphasizing the faith that a reliable and conservative railroad management has in the economical value of creosoting, sufficient to launch out independently and construct large works on its own account.

Creosoting timber with dead oil of coal tar (creosote oil) after the proper dessication and preparation of the timber, is not a new patented process. It has been successfully in use for over fifty years. The able report of the "Committee on the Preservation of Timber" of the American Society of Civil Engineers, says:—"If the timber is to be exposed in sea water to the attacks of the *teredo-navalis* and *limnoria terebrans*, there is but one antiseptic which can be used with our present kyowledge; this is creosote or dead oil. If the timber is to be exposed in a very wet situation, creosoting is also the best process to use. If the exposure is to be that of a railroad tie, creosoting is doubtless the most perfect process to use."

A brief summary of the process may be of interest to some of our readers, although we would refer them for a more perfect and exhaustive description of the principles and methods used to the report of the Committee of the American Society of Civil Engineers, just referred to. The process can be classed in two divisions, viz.: the dessication and preparation of the lumber for the receipt of the antiseptic and the introduction of the same. The first is accomplished by steaming the lumber in closed cylinders with live steam and then pumping a vacuum, maintaining the heat by means of steam coils in the cylinders. When all sap and moisture are removed from the lumber, the pores opened and the air exhausted, the hot oil is turned into the cylinders and quickly drawn up by the lumber. In some qualities of timber very little subsequent pressure is needed to get the required amount of oil into the wood, while with others and where a large amount of oil is specified, a pressure up to 150 lbs. per sq. in. has to be maintained for hours before the desired results are attained.

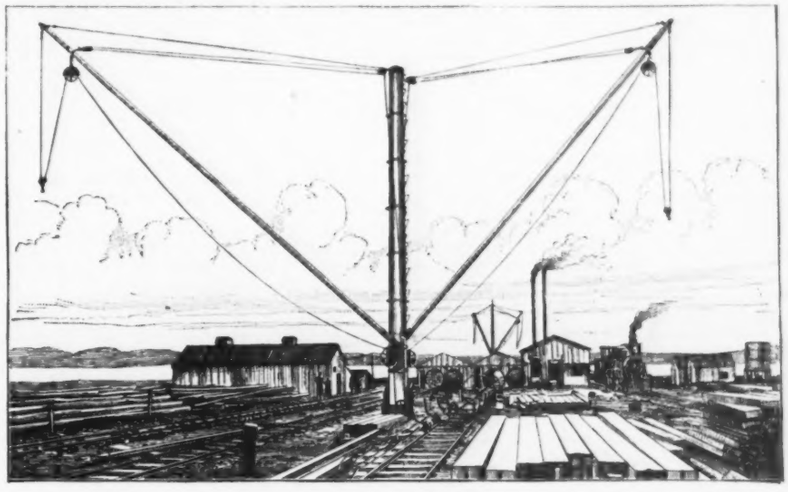
According to the quality of the wood and the use it is to be put to, the amount of oil required to be forced in is from 8 to 20 lbs. per cu. ft. of timber.

An examination of the Lehigh Valley Railroad docks at Perth Amboy, N. J., some years ago and about eight years after their first construction, made by a diver along the outside row of piles, showed about every third or fourth pile completely eaten off by the marine worm or the teredo. The foundation of the interior could not be examined by the diver for obvious reasons, but the inspection of the outside rows was sufficiently indicative of the general condition of the foundation to call for a condemnation of the whole structure, independent of the condition of the upper deck iron work, machinery and tracks. To reduce the thus resulting waste of materials in good condition, the extra expense of frequent renewals and the inconvenience of throwing the dock out of service, owing to a defect in one part of the structure only, the railroad company adopted creosoting as the best preventative against the attacks of the marine worms and general decay. After several large jobs had been done by contract, the company decided to build works of their own, and the result is the erection of large works equal in working capacity to any others in the country, when the extensive improvements contemplated and in course of construction are completed.

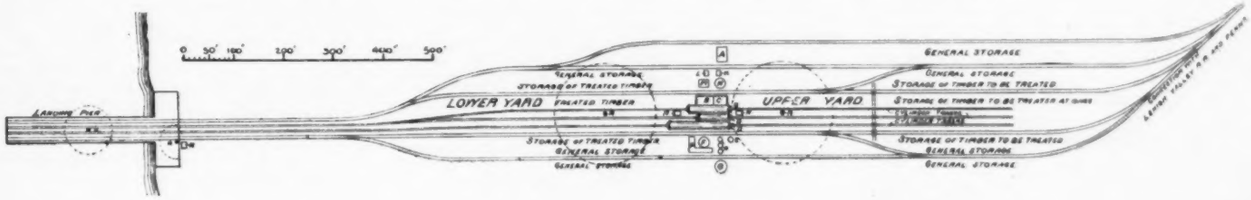
We present herewith a ground plan of the system as it will appear when finished and a cut showing the works at present. The plant consists of two large steel cylinders, 6 ft. in diameter, and respectively 60 ft. and 80 ft. long (with all arrangements made for the addition of a third cylinder, 120 ft. long.) The cylinders are open at both ends, with narrow gauge tracks running through them. There is an extensive yard at each end of the cylinders, equipped with large, double armed derricks worked by steam winches. In addition there is the engine house with the steam, vacuum, oil and water pumps and the boiler house with boiler and superheater. The location of the other structures, as storage tanks, working tank, receiving tank, store house, chemical laboratory, tool house, water tank, office, landing pier, and lumber yard are shown on the plan.

The design with cylinders open at both ends and a regularly equipped yard at the upper and lower end of the works is believed to be an entirely new feature for timber preserving works, the usual method being to have one end of the cylinders closed permanently. A glance at the ground plan will show the convenient manner in which the railroad tracks encircle the works and run through the lumber yard to the landing pier at the water front. The general system presented offers great advantages in the handling and moving of the timber used in the process, and for shipments by rail or water. The distribution of the yard space as marked on the plan is for shipments by rail; for shipments coming from the water front the arrangement is slightly reversed.

The works were built by the Lehigh Valley Railroad Company, under the supervision of A. W. STEDMAN, Chief Engineer, and WALTER G. BERG, Assistant Engineer.



Lehigh Valley Creosoting Works; General View.



Lehigh Valley Creosoting Works; Plan.

EXPLANATIONS.—*A* Office—*B* Boiler Room—*C* Engine Room—*D* Cylinders—*E* Receiving Tank—*F* Working Tank—*G* Storage Tanks—*H* Water Tank—*K* Laboratory—*L* Store House—*M* Coal Bin—*N* Hoisting Engines—*P* Runway for Oil Barrels—*R* Derricks.

PUBLICATIONS RECEIVED.

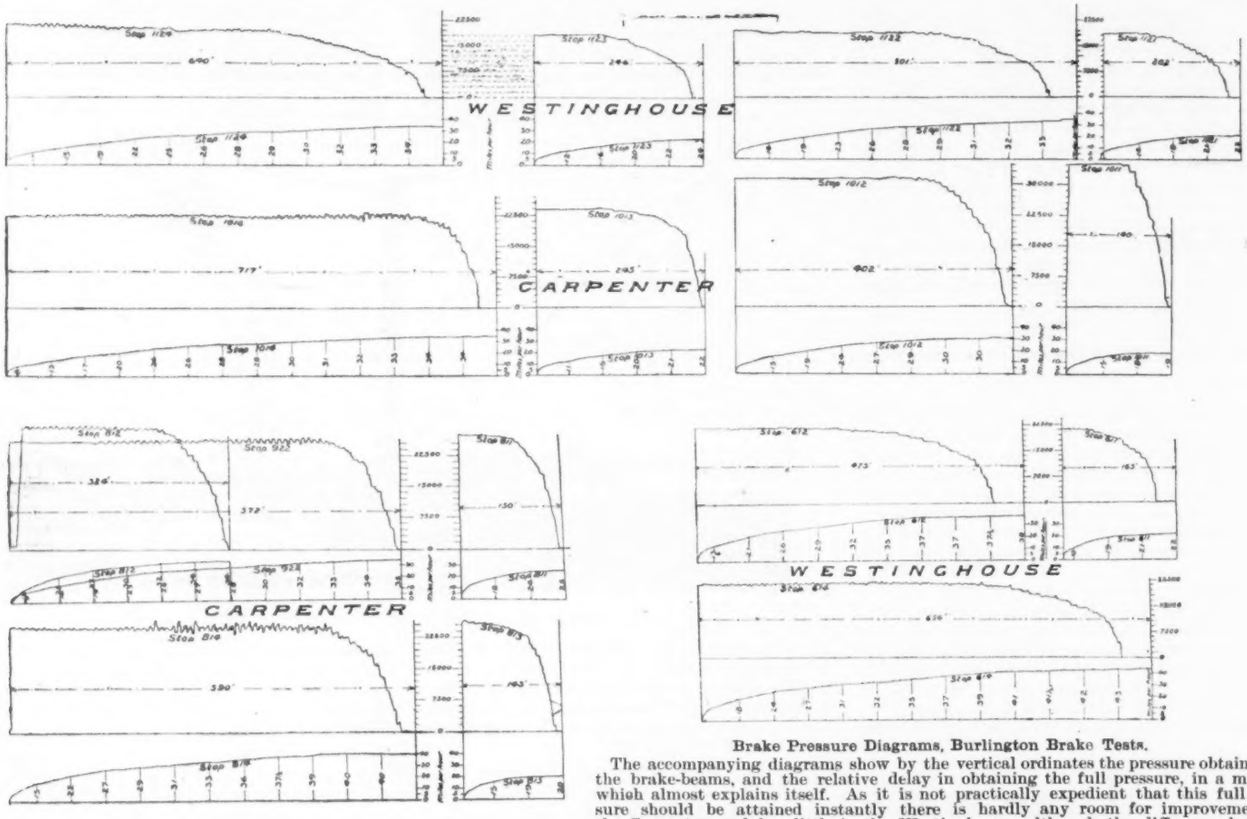
Statistical Abstract of the United States, 1886. Prepared by the Bureau of Statistics, Washington, D. C., pp. 202; 188 tables.

This valuable publication grows yearly better, its distinguishing and most valuable feature being the way in which the records are carried back over a long term of years. In this respect the report might well be studied by those who have to get up reports of any kind.

Technology Quarterly, Vol. 1, No. 1 appears dated September, 1887. This publication is to be regularly issued by the Massachusetts Institute of Technology, of Boston and the first number is most creditable both in its contents and its typographical appearance. The board of editors is selected from the senior and junior classes of the Institute, so as to represent each of its departments, and WM. S. HADAWAY, JR. is now the editor-in-chief. The initial number contains about a dozen different articles on a number of subjects, which in their treatment would do credit to older heads.

The Sabula Draw by Graphics. A Practical Illustration of the Application of Graphics and a Comparison with Analytical Methods. By MALVERD A. HOWE, C. E. Chicago, 1886, *The American Engineer*, Publisher. Price, $1.00.

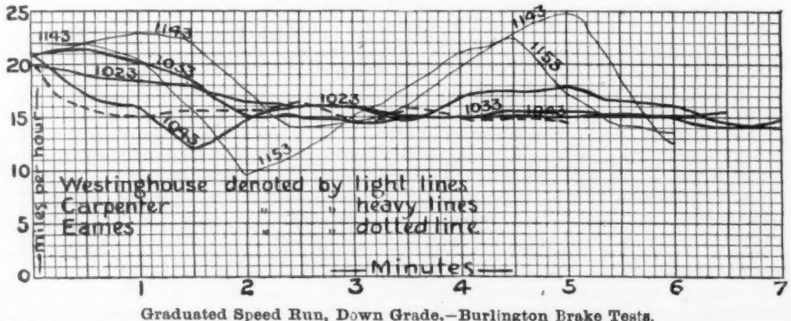
This a detailed analysis of a single-track draw-span of 360 ft. with a center height of 40 ft. and end verticals of 25 ft. The strains are deduced both by analytical and graphical methods for all members, so that a comparison can be made. The text is fully illustrated with stress diagrams, full details and the specifications under which it was built are also included. Mr. HOWE has handled his subject in so clear a manner that his work should be found useful by young engineers especially.



Brake Pressure Diagrams, Burlington Brake Tests.

The accompanying diagrams show by the vertical ordinates the pressure obtained on the brake-beams, and the relative delay in obtaining the full pressure, in a manner which almost explains itself. As it is not practically expedient that this full pressure should be attained instantly there is hardly any room for improvement in the Carpenter, and but little in the Westinghouse, although the difference between the two in this respect account for a large part of the difference in per cent. of efficiency. The Eames were not nearly so good as either of these in this respect, and yet made a good and creditable showing. Beneath the brake pressure diagram is a diagram showing the reduction of speed, with the actual speed in miles per hour for each 50 ft. of stop. Theoretically these lower diagrams should be parabolas.

The serrated form of the brake pressure diagrams is due merely to mechanical vibration of the brake-rods, and not to undulations of pressure.



Graduated Speed Run, Down Grade,—Burlington Brake Tests.

This test was to approach the top of a 1 per cent. (52.8 ft. per mile) grade at 20 miles per hour, check the speed down to 15 miles per hour gradually, and hold that speed for about a mile and a quarter. The Carpenter and Eames brakes made about an equally favorable showing, as will appear from the accompanying diagram. The Westinghouse did not do so well, for reasons explained below, but made about the same showing as last year.

CORRESPONDENCE.

Another Old Treatise on Surveying.

PITTSTON, PA., May 16, 1887.

EDITOR ENGINEERING NEWS:

I have on my shelves an old work on surveying that antedates in publication by one year, the one mentioned by Mr. LOW, of Leechburg, Pa., in your issue of the 14th. inst. The title page is: "*Geodæsia: or the Art of Surveying and Measuring of Land, made Easie. * * * * By John Love, London: Printed for John Taylor at the shop in St. Paul's Churchyard*, 1688. It is dedicated to the well known ROBERT BOYLE, Member of the Royal Society.

In dimension it is 6-in. x 7¼-in. and has 246 pages. It has a traverse table, a table of sines and tangents and a table of logarithms. In the preface the author speaks of surveying in America, in Carolina.

JOHN W. BERRY.

[As a slight check upon correspondence of this nature we would mention that we have in our own library a book entitled *The Moste Profitable and Commendable Science of Surveying of Lands, Tenementes and Hereditaments: Drawen and Collected by the Industrie of Valentyne Leigh. Imprinted at London for Andrew Maunsell, Anno Domini*, 1577. If any of our readers can antedate Mr. LEIGH'S production, which he tells us was written in 1562, we should be glad to hear from them; otherwise let them hold their peace. ED. ENG. NEWS.]

Bad Drainage of Side Hill Cuts.

NORTH ADAMS, Mass., May 9, 1887.

EDITOR ENGINEERING NEWS:

I send you herewith photographs of the recent land slide accident at Millers Falls on the Fitchburg Railroad which happened at 11:30 P. M. on the night of May 6. I went there yesterday myself to see what there was of it, and found that the land slide *per se* was of insignificant proportions, probably not more than 30 or 40 cu. yds. of stuff came down. It was sand, gravel and mud and perhaps a boulder. The banks in the vicinity are neither steep nor dangerous in appearance, though there are numerous springs of water flowing out and they are probably underlaid with clay. The moon was shining at time of accident, but the debris on the track were in shade. The engineer saw it too late to avoid it. He reversed and stuck to his post and came out all right. The fireman jumped and got off with slight injuries, one brakeman was killed.

Yours truly, HARRY E. BLAKE.

[The photographs which our correspondent encloses are chiefly interesting for what they do *not* show. As it is hardly worth while making pictures for what they do not show we do not reproduce them, and yet, they are well worth studying by an engineer of maintenance of way. In a word, the roadbed was double track and cut on a tolerably steep side-hill, about 100 ft. above the river. The slopes both above and below the roadbe look all right and not unduly steep, nor is there the least evidence of a land-slide in the photographs, other than the wrecked locomotive and train. At the point of the disaster the inside slope was about 20 ft. high and a thin layer of material slipped off from it, obstructing the inside track. This derailed the locomotive, which stuck in the crest of the lower slope, and a quite general smash-up followed. Had the train been a passenger, there would have been likely to result a very similar disaster to that at West Deerfield, Mass., last year, a few miles west of the situation, as we noted May 7, but whereas that accident was clearly shown to have resulted from the covering over of old ties in the bank, in this case everything was all right and in excellent order *except the drainage*,—an important exception.—ED. ENG. NEWS.]

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The following is the list of candidates found elected on canvas of the ballot at the last meeting, May 4. By an error of a clerk, the wrong list was sent us for publication in our last issue.

FOR MEMBERS.

RICHARD MILFORD BERRIAN, formerly Div. Eng. Fourth Avenue Improvement, New York City; Asst. Eng. New York & Manhattan Beach Ry.; Div. and late Chief Engineer Boston, Hoosac Tunnel & Western Ry. on locations and construction in New York State; recently Div. Eng., New York, Lackawanna & Western Ry.; Chief Engineer Atlantic Coast, St. John & Indian River Ry.; residence, New York City.

JOHN STERLING DEANS, formerly Asst. to Gen. Sup. Harrison Bros. & Co., Chemical Works, Philadelphia; engaged with Clarke Reeves & Co. during construction Elevated Rys. in New York City; engaged in Engineering Dept. Phœnix Bridge Co.; Engineer on erection Rondout Creek Bridge, West Shore Ry.; now Assistant in Estimating and Designing Department Phœnix Bridge Co., Phœnixville, Pa.

JOHN ADDISON FULTON, (Univ. Mich. 1871), formerly in charge of construction 10 mile division Cincinnati Southern R. R.; Division and Locating Engineer Atchison, Topeka & Santa Fé R. R. and Atlantic & Pacific R. R.; recently Ass. Eng. Smith Bridge Co., Toledo, Ohio; Locating Engineer and now Rest. Eng. Chicago, Santa Fè & California Ry.; Kansas City, Mo.

WILBUR FRANCIS GOODRICH, formerly engaged on Nashua & Lowell R. R.; on Locks and Canals on Merrimac River; Asst. Eng. Massachusetts Central R. R.; Asst. Eng. Fitchburg R. R.; Asst. Eng. New York & New England R. R.; recently engaged with City Engineer of Cambridge, Mass., and Mass. State Drainage Commission; now Rest. Eng. Toledo, St. Louis & Kansas City R. R., Kokomo, Ind.

JOHN ROGERS HUDSON, formerly Asst. Eng. Nevada Ry.; Rest. Nevada Central Ry.; Chief Engineer Southeastern extension Eureka & Palisade R. R.; Chief Asst. Eng. Utah & Wyoming Ry.; recently Chief. Asst. Eng. San Joaquin & Sierra Nevada R. R.; Asst. Eng. Compania Mexicana Colonizodora de Ferrenos del Colorado; now engaged in General Engineering, Pomona, Cal.

FRANK ADOLPH LEEBS, (Industrial Coll. Cologne, 1864,) formerly engaged on Prussian Government Surveys (Assistant in Department of Cadastre); Mechanical Engineer for Eberhard Hoesth and Sohns, Düren, Germany; Constructing Engineer Mines and Smelting Works; engaged in Frumet Lead Mines of Missouri; on St. Louis Bridge; Engineer Meyer Iron Co., Bessemer, Ill.; with Messrs. Flad and Pfeiffer, St. Louis; Geological Survey of Mine la Motte, Mo.; Assistant Engineer Superstructure New York Elevated and Brooklyn Elevated Rys.; now Engineer Passaic Rolling Mills and Bridge Works, Paterson, N. J.

JOHN GEORGE MACKLIN, formerly engaged on Railroads in North Wales; First Asst. Engineer International Bridge Works at Buffalo; Chief Engineer St. Lawrence & Ottawa Ry.; now Chief Engineer Midland Div. Grand Trunk Ry.; Peterborough, Canada.

DAVID LOWBER SMITH, formerly Asst. Eng. Dept. of City Works, Brooklyn, N. Y.; Asst. Engr. Water Purveyor, First Asst. Engr. and now Deputy Commissioner Department of Public Works, New York City.

FOR ASSOCIATE:

ROBERT JAMES PRATT, (Rens. Pol. 1883.) Electrician and Manager Electric Manufacturing Co., Troy, N. Y.

FOR JUNIORS:

EDGAR BONAPARTE GOSLING, (School of Mines Columbia Coll. 1885.) engaged in Engineer Department, Department of Docks, New York City.

ALFRED MILTON MOSSCROP, (Cornell Univ. 1885.) formerly engaged on Adirondack Survey of New York State; City Surveyor of Brooklyn; engaged on King's Co. Elevated R. R.; Missouri Pacific Ry.; now Instructor, Department of Civil Engineering, Cornell University, Ithaca, N. Y.

EDWARD WALTER RATHBUN, Assistant Engineer Napanee, Tamworth and Quebec Ry.: Napanee, Canada.

WILLIAM PLUMB WILLIAMS, formerly Mechanical Engineer for American Contracting and Dredging Co.; Asst. Engr. Mexican International R. R.; recently Asst. Engr. Atlantic Coast, St. John & Indian River Ry. in Florida; Asst. Engr. West Shore R. R.; now Asst. Engr. Electrical Subway Commission, New York City.

Engineers' Club of Philadelphia.—Record of Regular meeting May 7th, 1887. President T. M. CLEEMANN in the chair; 19 members present. The Secretary presented an illustrated paper by Mr. LEWIS N. LUKENS upon "Some Remarkable Breaks in a Reservoir." "The reservoir was built in 1873 on the top of the Conshohocken hill, about 200 ft. above the level of the Schulkill river, from which the water is pumped. In plan it is a square of 151 ft. at the top of the embankment, with a division embankment rising half way to the top of the side walls. When ordinarily full it holds about 1,000,000 galls.

"The earth of the locality is of a rather light character, with enough talc in it to make it feel rather greasy. The general rocks of the locality are limestone, and the variety quarried and sold as Conshohocken stone. The exact geological conditions of the locality I have not knowledge enough to describe.

"In constructing the reservoir the banks were raised about as much above the natural level as the excavation was beneath it, the earth from excavation being used for the embankments. These were well rolled and allowed to settle as much as possible in the course of construction. The bottom and sides were then lined with 18 in. of stiff fire-clay, put on in layers of about 3 in. each, layer being well rammed. Above this there was put a brick pavement and this was washed over with hydraulic cement.

"The inlet and outlet pipes were cast-iron pipes laid in masonry. This masonry was composed of ordinary undressed stone, laid in hydraulic cement and extended out to about the middle of the embankment.

"The reservoir was finished in the fall of 1873, and water was let in soon after. In December, 1873, only a few months after the water was let in, the first break occurred. This break commenced just above the outlet pipe and followed the line of the pipe through the embankment, laying bare some of the masonry described as surrounding the pipe. It broke through the embankment just about at the natural level of the ground, and was about 15 ft. across at the top of the embankment, narrowing, of course, towards the bottom. The curious part was, however, that instead of the ground below showing evidences of such a large body of water passing over it, it showed that only a comparatively small part of the water had escaped that way and covered the low land just below. The larger part of the water must have escaped by some other channel, necessarily a subterranean one. This first break was repaired by filling in with stiff fire-clay and finishing as before. In the summer of 1876 the second break occurred. This was in the middle of the west compartment and was an absolute giving way of the bottom, there being no break in the sides. It was simply a hole of about 25ft. in diameter and of indefinite depth. A line was let down at least 85 ft. without finding bottom, and stones thrown in seemed to rattle down indefinitely. The ledges of rock seemed to be inclined toward each other, thus V, and the slippery talcous earth had been washed from between them, nobody knows where. Whether the water from the first break started it, is of course not known, although it seems, at least, possible.

"In repairing this, the crevices between the rocks were filled up and arched over with masonry, going as deep as necessary to get a solid support for the masonry, in one case as much as 34 ft. below the bottom of the basin. The hole was then filled in with stiff clay and iron ore screenings, principally clay. The top was then planked over with hemlock planks, and the clay lining rammed down and covered with brick, as before.

"In the spring of 1879, three years after, the third break occurred. This was in the other compartment, taking away part of the partition wall and part of the bottom, and was a good deal like the preceding one. An interesting fact is that a well near by, 80 ft. deep, and which had had 8 or 10 ft. of water in it, was completly emptied the night the break occurred and has not held any water since. There must have been some underground channel by which the water from both found its way to the river.

"This hole was filled up with masonry and clay, like the other. The clay lining was then taken off, and the whole basin,—sides, bottom and partition embankment,—were planked over with heavy hemlock plank. The clay was then put on again to a depth of 14 in. and the whole surface bricked as before. This time it lasted for eight years, until last fall when a small break occurred. Some small quantity of water had washed the earth from between two rocks, in the side of and near the bottom of the end embankment, in the same old way. The weight of the superincumbent water had then sprung back the side planks, and the water had escaped by some underground channel. Being relieved of the weight the planks had sprung back. The fact of the springing back and subsequent release, is shown by there being a number of small fish caught and crushed in the cracks. This was repaired, as usual, by filling in with fire-clay, and at that particular place there is now 3 ft. of fire-clay rammed in between the rocks, then the planking, then 14 in. more clay, and then the brick lining. It is hoped now that it will last."

Capt. S. C. MCCORKLE exhibited a map of the rivers in the vicinity of New York, made for commercial purposes, and referred to the proposed preparation of a similiar map of the rivers in the vicinity of Philadelphia, requesting the discussion of the subject by the Club.

It was suggested that the Schulkill River above Fairmount dam be included in the survey and plan, as a great convenience to some 1500 members of the Philadelphia rowing fraternity, but Capt. MCCORKLE stated that the government work could not be extended above tide water.

It was also suggested that it would make the map more generally useful if the streets and other topography were extended cross the city or farther inland, instead of, as in the New York map, only showing the wharves, piers and other water front lines.

HOWARD MURPHY, Secretary.

Engineers' Club of St. Louis.—Meeting of May 18, 1887. The club met at 8.15 P. M. at Washington University, President POTTER in the chair, twenty-one members and two visitors present.

Mr. R. E. MCMATH, chairman of the committee on National Public Works, made a report stating that no recent progress had been made. On motion the report was received and the committee discharged. Mr. MCMATH was directed to remit to the treasurer of the National Committee the funds in hand for that specific purpose and to express to the officers of that body the sentiment of the club on the subject—which is not favorable to further agitation of the matter at present.

Mr. H. A. WHEELER then read a paper on "The Relative Economy of Machine and Hand Drilling." The subject was carefully reviewed, and the various factors entering into the problem were explained and discussed. A comparison based upon results in St. Louis limestone quarries showed an economy of 20 per cent. in favor of the machine. A comparison of work at the Conglomerate mine showed, in drifting, 5 per cent. in favor of the machine, but in sinking hand work showed a superiority of 20 per cent. The comparisons were made upon the relative cost per foot of hole drilled, and did not include the factors of quantity of material removed, speed required and ventilation. The value of each of these factors could only be determined by an investigation into the special requirements of each case. They should always receive attention as they have an important bearing on the problem.

The discussion was participated in by Messrs. HOLMAN, MELCHER, SEDDON, MOORE, POTTER and STOCKETT.

The question of the relative cost of mining coal by machine and by hand was also brought up. It was stated by Mr. STOCKETT that he had accumulated data showing 15 to 20 per cent. economy in favor of the machine. The principal advantage of machine work was its effect on the labor question. Adjourned.

WM. H. BRYAN, Secretary.

Civil Engineers' and Surveyors' Association.—The Annual meeting of the Connecticut Civil Engineers' and Surveyors' Association will be held at the office of CHAS. E. CHANDAER, 161 Main St. Norwich, Conn. on Tuesday, June 7th. There will be excursions to points of engineering interest during the day, and at 7 P. M. a paper on "The Relation of Photography to Engineering" by W. H. BURNETT, of Norwich, will be read.

Farmer—"Gwine to run a railroad through my barn?"

Surveyor—"I don't see how we can avoid it."

Farmer—"Waal, now boss, I reckon I got suthin to say about this; I got suthin else to do besides runin in an' out to open the doors of that thare barn every time a train goes through"

Court House and Jail.—The contract for the construction of the court house and jail at Murphyville, Tex., has been awarded to Tom Lovell, of that place, for $27,000.

ENGINEERING NEWS

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D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.
GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year; $2.50 for Six Months; $1.50 for Three Months; Single Copies, 12 cents.* FOREIGN COUNTRIES, $6.56 *per Year, or 3 cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Mr. H. D. WOODS, C. E., of Boston, Mass., writes us that he was in no wise responsible for the uncredited use of our Bussey bridge illustrations by *Le Genie Civil*, referred to in our last issue. Mr. WOODS wrote the article and furnished drawings and photographs, one of the latter being the same as that from which our general view was taken; but in preference to making a new drawing, our Paris contemporary used that made by us without warrant from its Boston correspondent. The close description of the broken parts of the hangers by the author and the use of an illustration which could only have come from this journal, made our assumption that this illustration accompanied the article pardonable, but as Mr. WOODS assures us that he did not send *any* of our views, we heartily apologize to him for any wrong done under this assumption. And it now appears that *Le Genie Civil* not only appropriated our illustrations, but also did the greater wrong of foisting them upon an innocent correspondent. It is hardly necessary to assure Mr. WOODS that no slight was intended to the justly famous school of which he is a graduate by our allusion to his official title.

The Engineer in its last issue attempts to explain away what we must regard as its unworthy and absurd attempt to prejudice the British colonist against American engineers and bridge-builders as a class by holding up the Bussey bridge as a fair sample of what will happen to them if they desert the home shops. It remarks:

"ENGINEERING NEWS says that probably we have forgotten all about the Tay bridge disaster of December, 1879. We hasten to assure our contemporary that we have done nothing of the kind. No subsequent event of a similar nature has occurred to obliterate from our memory that disaster. *It stands out a unique fact in the history of British railway enterprise.* It was the only iron bridge of any dimensions which has ever given way causing loss of life in Great Britain."

Our contemporary might have gone a little beyond in the italicised statement. The fall of the Tay bridge "stands out a unique fact" not only in the history of British railway enterprise, but in the whole history of engineering. Rightly considered, if such an arraignment could ever be proper, it would alone go farther to discredit the engineering of a whole people, than a dozen or even a hundred such instances as the Bussey bridge. We are bound to believe *The Engineer*, of course, when it claims not to have forgotten the Tay bridge, in making its charge, but it drives us to the only remaining possibility,—that it was in hopes its readers would have forgotten it—at least in the colonies—for that any one would attempt to use the poor little "Tin" bridge in this way with the Tay bridge incident in his mind and (presumably,) in the minds of his readers, is not supposable.

For, since *The Engineer* has not only begun but continued this wretched style of argument, we may recall more in detail that the Tay bridge was an immense structure, 10,395 ft. long, supported on 85 piers. It was building from June, 1874 to June, 1877, and 18 months later, 13 spans and piers complete fell under a light train. It was in a high gale of wind, it is true, but the expert report was that it had been previously strained in earlier gales, had begun to show signs of weakness a few weeks after it was opened, had been "entrusted for supervision to a man who possessed no experience in structures of iron" (This has a certain familiar ring) and that "the workmanship and fittings were inferior in several respects," while the worst fact of all connected with the structure was that the hexagonal piers, made up of six practically vertical columns *were not cross-braced at all so as to be geometrically rigid*, such bracing as there was being of a very imperfect character.

Yet this structure was widely illustrated and talked over during the four years preceding its completion, and the particular question of its stability to resist wind-pressure was raised before it was opened, and its designer knighted in consequence. No one of its "large staff of assistance and inspectors," however, nor of the engineers who had visited and read of it, raised a warning voice against this unprecedented mistake during all that long time.

As for the Tay bridge being "the only iron one of any dimensions which has ever given way causing loss of life in Great Britain;" it may be so, but there is a little fact which leads us to take this statement with a great many grains of allowance. The official report on the Tay bridge disaster was rendered June 30, 1880. In looking for it we by mere chance lighted on the following item in the immediate context:

AN ENGLISH BRIDGE ACCIDENT.

A dispatch from London, June 18, says: "A bridge on the Hereford, Hay & Brecon Railway, a small branch line in Herefordshire, broke down under the weight of a goods train this morning, precipitating the train into the river *and killing the engine driver.* The presumption generally entertained is that the bridge had been weak for some time."

We opine from the context that this bridge was an iron one, and we are quite sure it had "dimensions." Therefore we strongly suspect that *The Engineer* in its sweeping claim for British bridges, has allowed the wish to be father to the assertion as well as to the thought.

It must be remembered, if any one should be tempted to make such comparisons hereafter, that the English railway mileage is only about one-eighth of ours, and was mostly completed before the iron truss era began. Moreover, there are in England hardly any streams which would be dignified with the name of rivers in this country, excepting the various estuaries. There are, therefore, vastly fewer small iron railway bridges (always the most dangerous class) in that country than here; brick, stone, and heavy cast-iron arches having been very largely used instead. Making a somewhat hazardous guess, which may be far out, we should say there were fully one hundred times as many iron railway girders here as there. Many more failures are to be expected in this country therefore, apart from two facts which we are quite ready to admit and even to insist upon; that the margin of strength in a large proportion of our bridges is too small for true economy, while, on the other hand, many of the English iron briddes, whatever their other defects, have a virtue which they share with the Pyramid of Cheops, it is very hard to knock them down, and for much the same reason, an unnecessary superfluity of material. A compromise between the two plans is what is needed, the English free use of material and the American skill in getting the most strength from it per ton.

The Engineer tells one story against us, however, which is so good and so pat that we must quote it:

"ALBERT SMITH used to tell a story of a Vauxhall waiter who, being asked *how* thin he could cut ham for sandwiches, replied that "he really did not know, but that he would undertake to cover the whole garden with four hams." On the same principle American engineers exist and practice, who can carry the art of sub-dividing material and workmanship to an incredible extent."

Indeed they do, but the remedy lies in a few little simple words combined into a specification, as to the number of sandwiches to be made from a ham, and not in abusing the man's skill, which is a good thing in itself.

THE London *Architect* in commenting upon the existence in Ireland of all the materials necessary to make excellent Portland cement, and the further testimony of Mr. STONEY that his only objection to it was that it could not be supplied fast enough for his Dublin harbor work, concludes its statement with the following significant remark—"At a time when German cement is imported in large quantities, there can be no dissatisfaction in England at the creation of the new industry in Ireland." And yet the *Architect* no doubt wonders at the dissatisfaction of the Irishman with a condition of affairs which makes such a question possible in a country where only the common good should be considered.

IF the purchase of the unlucky Mexican National line by the Louisville & Nashville interest means what it is supposed to mean, the practical extension of that system to the city of Mexico, it is a most significant illustration of the tendency of the time. The Louisville & Nashville system is already an immense agglomeration, and it is now pushing several new extensions in what may be called the home region. By this purchase it comes into direct competition with the Missouri Pacific, the Atchison, Topeka & Santa Fé, and the Southern Pacific, powerful and active corporations, each having 5,000 to 7,000 miles of line, and becomes one of our most important great systems, while it will be in a position to deal the Mexican Central very hard blows indeed.

A contract is stated to have been entered into with the Missouri Pacific for a connection between New Orleans and Laredo, but this great gap will not be likely to be left in foreign hands forever. It rather implies the eventual construction of another main line across Texas, and as each main line necessarily means a system of branches as well, it means continued active development in the empire of Texas, which just at this moment, seems almost to have been partitioned up between Gould's Missouri Pacific and the Atchison, Topeka & Santa Fé. The permanent entry of another great competitor for the Texas traffic can hardly fail to be of much advantage to the state, and promote its still more rapid development. There can be no question that the general route of the Mexican National is the natural one between that country and this, or that it will take the lion's share of the

traffic. Why this is so is partially clear from a mere glance at the map, but it becomes still clearer when one studies the distribution of population and wealth in Mexico, and finds that the northern half is almost a desert waste, while a little section around and just north of the city of Mexico, contains about *four-fifths* of the population of the country in about *one-fifth* of the area. The Mexican Central had the choice of either route when the concessions were given out, and chose the longest; which was undoubtedly an error of judgment, although a most natural one under all the circumstances.

ENGINEERS who have had to rough it "out West" may feel some envy of their brethren "down South" when they learn from the *Atlanta Constitution* that at Lawrenceville, Ga., when the party who were running preliminary for the Georgia, Carolina & Northern Ry., were near that place; "People all along the line quit their shops and fields, and the citizens in the town their different businesses, *to aid them in getting the best route.*" We seem to remember that this sort of thing is not peculiar to the Sunny South, but it is everywhere preferable to be met in this way rather than by the time-honored bull dog and shot gun.

Again, whoever has had to go to bed hungry, and lie in the mud, a thousand miles from nowhere, very often, will read with envy that it is getting to be far from uncommon in Southern towns which have any earnest desire to "boom," for a committee to greet the surveying corps on their arrival, fill them up with a sumptuous banquet, and close the evening with a grand reception and ball. This sort of thing cannot go on long before all the younger members of the profession will be crying to go South. It happens occasionally everywhere, but the bloom of novelty has rather gone off from "new railroads" in the Northern States, even in the country regions. The honest farmer is rather disposed to look askance at the "Surveyor," as shown in the veracious anecdote given elsewhere, which we find in an exchange.

A NEW storage battery which is claimed to possess remarkable advantages, has recently been invented by Messrs. MESEROLE and MAIN, of this city. The negative electrode is made of a different compound (largely zinc) from any heretofore in use, with the double advantage that it has three-eighths less weight and a 50 per cent. higher electric tension per cell than any others now in use, or 3 volts instead of 2, which is certainly a remarkable achievement, if it can be realized in practice, and one which has been generally regarded as impracticable. The device is owned by the River & Rail Electric Light Co., of this city.

The same company control also a new electric motor, the invention of Mr. WM. MAIN, which certainly has some interesting and novel features. Its only revolving parts are a plain iron cylinder with projecting iron arms. No wire coils whatever are in motion, so that the moving parts are much lighter. The ordinary electric motor consists of two parts; (1.) *The field magnet*, a stationary frame of iron, wound with wire, and magnetized by an electric current the direction of which remains constant, and (2.) *The Armature*; a series of wire coils arranged in an annular or cylindrical system through which intermittent or reversed currents are directed by a cylindrical system of connections called a *commutator*. This armature is, in a motor, set in rapid rotation by a current forced in from outside. In the MAIN motor the armature is stationary and forms the circumference of the machine, the action of the electric forces differing from that of the ordinary motor, as the inventor puts it, much as a turbine water-wheel differs from an over-shot wheel. The motor "motes;" to so much we can testify, and while the devices referred to have not yet fully passed the experimental stage, they are certainly very interesting experiments. A street car is now being constructed to be fitted with these motors and storage batteries, and a test of it will shortly be made.

THE "Question of Dynamics" which was raised in an issue of May 14, 1886, is discussed controversially by two correspondents this week, as we expected would be the case. It has not seemed well to do more than briefly outline what we deem the error of our correspondents in the foot-note which follows their letters, because we have received some bullets which have been shot together in the way suggested, and which are more instructive arguments than many words. We shall present views of these bullets shortly, and in the meantime commend the problem to further consideration, as an interesting and instructive one.

The Commission Report on the Bussey Bridge Disaster.

The Commission report on the Bussey bridge disaster is a very carefully prepared and, on the whole, satisfactory document, but adds little or nothing to the facts which were known immediately after the disaster. It is illustrated with heliotypes giving views of the bridge and of the wreck, made from the same negatives as our own views, with a map of the locality showing that the bridge was 0.60 mile from Roslindale and 0.64 mile from Forest Hill, and with rather imperfect sketches of the hangers. No views of the fractures are given, and the fact that there were two old breaks in the best hanger is not stated, perhaps from a natural feeling that even without it the hangers were about as bad as seemed possible in view of the work that they had done.

It seems quite clear that the speed was fairly high, perhaps 30 miles per hour, or even a little more, since there was a down grade of nearly 50 ft. per mile. The little diagram which we published in our issue of April 30, will show that it is a matter almost of indifference what the initial speed was as respects the ameliorating effect which automatic brakes would have had on the wreck, had such been in use. Whatever the speed, the braking effect of the smash-up alone sufficed to stop the train in 100 ft. less than its own length, and the diagram referred to shows conclusively that automatic brakes would have been easily equal to the duty of stopping the train in three to four car-lengths at any speed under 40 miles per hour, while "most of the people who were killed were in the fourth, fifth, sixth and ninth cars," as the official report states. There were, however, fewer killed than at first reported, as so often happens; only 23 in all, with over 100 injured, half of them seriously.

The Commission are very severe on the carelessness shown in the purchase and erection of the bridge, with absolutely no check on the competency of the builders, on their fidelity to their trust, or on the final quality of their work. Abstractly, they are none too severe, for they could not be, but it detracts a little from the force of their remarks, that in this respect the Boston & Providence hardly exaggerated the almost universal usage in buying bridges, as well as rails and such like supplies. Hardly more than a year ago there was, to our knowledge, a double track bridge erected in Eastern Massachusetts of such very bad metal that even the makers of the iron protested against it, and throughout the country the rule and not the exception is to buy such things almost on trust. It is to the credit of our manufacturers that this trust is so seldom abused, and yet in one respect such an unnatural way of dealing with such important interests must always lead to abuse: The margin of security will always tend to be too close for true economy, from the simple fact that to be able to compete at all the bridge builder must make his margin close, however much he may dislike to do so. But one result can follow: The more ignorant and more unscrupulous competitors will often win and occasionally go a little too far, as in this case.

The ridiculous spirit of economy shown in renewing the bridge half a span at a time twice in succession, is touched upon very lightly, in fact, is not directly censured at all, although it is one of the most reprehensible things about the structure, for it did not need engineering knowledge, but simply common sense, to know that such construction was improper.

The Board likewise animadvert very properly on the crude system of heating in use and specify that at least three different fires started in the wreck, and were only put out by the fortunate nearness of water and the fire department, to which might well be added a third reason, that the first three cars escaped. Had the whole train gone through the bridge, a fearful holocaust would probably have resulted.

The Board likewise censure the company, but with very questionable propriety, for not having more brakemen on the train. It appears that there were only three brakemen, two assistant conductors, and one conductor on this train of nine cars, whereas an old law requires that there shall be "trusty and skillful brakemen, equal in number, at least, to one for every two cars in the train," which would have required five brakemen beside the three conductors. Such a number of train employés is unheard of in good practice, so far as we know, and furthermore, it is absurd. There is no reasonable use nor function for any such number. Neither is it necessary or customary for the brakemen to stand out on the platform all the time between stations, especially in winter weather. It never was so, even before the days of air brakes, to the best of our recollection, and it is one of the great advantages of air brakes that they render superfluous such a small army of employés and such continued exposure.

The Board also criticize very severely and very justly the dangerous floor system, with its 6 x 8 ties *averaging* 14½ in. apart in the clear, and some of them 18 in., without guard-rails, without re-railing safety-guards, and without long ties. No criticism can be too severe for such a floor, and yet in this respect also the Boston & Providence is in excellent company. In few other details is there so much and so general bad practice. The standard bridge floors of some of our leading trunk lines are but little better in essentials than that of the Bussey bridge. Again, while the very severe terms in which the continuing lack of proper inspection is commented on are none too severe, yet the Bussey bridge was looked after in much the same way as half the other iron bridges in the country, and even those roads which have engineers do not always permit them to discharge their functions. We know of one prominent line at this minute on which the chief engineer has recommended that the bridges be inspected, and he has been quietly instructed not to do so "at present," for the very good reason that it is quite certain an inspection would result in the condemnation of a number of bridges, and the company cannot

spare just now (what company ever can) the money to renew them.

In all the preceding matters the Commission are certainly none too lenient, which makes it the more surprising that the difficulty of inspecting the old breaks should have been so much exaggerated, as we noted last week, and especially that the continued use of an inferior type of train brake, in which the company was almost alone among the respectable railways of the country, should not have been more severely commented on. The terms in which the Commission do refer to this defect however are not exactly complimentary, for they are as follows:

"It appeared that seven of the nine cars on the train were supplied with the Westinghouse automatic brake. [Our information is very direct that there were a much less proportion of cars in the train equipped with automatic brakes, *both before and after the disaster*, but we must assume that this statement is correct.—ED.] but none of the brakes would work automatically because the other two cars had the old Westinghouse straight-air brake. Had the train been supplied with automatic brakes throughout, they would have applied themselves when the first car parted from the engine at the abutment at the north end of the bridge; they would have materially diminished the violence of the concussion of the cars against the abutment and against each other, and there is reason to believe that the results would have been less disastrous.

"A railroad company is bound to use the utmost diligence in supplying itself with well-approved contrivances for the safety of its passengers, and this railroad is guilty of neglect in not having, long ago, fitted all its cars with the Westinghouse automatic brake. Economy in some portions of railroad management is commendable, but economy which risks the safety of passengers is culpable."

We have left too little space to discuss properly what is after all the more important question,—what precautions should be taken, for the future. The findings under this head are as follows:

"The Board recommend the passage of an act requiring every railroad, at least once in two years, to have a thorough examination of all bridges on its lines made by a competent and experienced civil engineer, who shall report in writing to the corporation and to the Board of Railroad Commissioners the results of his examination, his conclusions and recommendations. The reports should embrace such information in relation to the history and construction of each bridge including detail drawings and strain sheets, as may be called for by the Board, and said Board should be authorized to employ a competent expert to examine such reports and make such further examination of the bridge structure as may be deemed necessary or expedient."

This is much the same measure of precaution as is now in force in New York State, and it is vastly better than none. And yet we fear it will not accomplish nearly all that is desired. The fundamental difficulty is that a bridge which is barely safe is not safe, and yet that a bridge which is even barely safe cannot be ordered down. The determination of whether it is even barely safe depends only on the judgment and fidelity of the inspector, who may be "competent and experienced" or may not. The competition of bridge builders and the penurious economy of bridge-buyers are still at liberty to interact upon each other unchecked to promote the construction of barely safe structures.

The better way would seem to be to specify certain absolute requirements as to bridge floors which must be fulfilled, to specify certain rolling loads considerably in advance of all ordinary requirements which all new structures must be proportioned to carry; to require riveted work up to a certain span, to specify severe and fixed penalties of the failure of bridges under strain, or for the absence of a proper floor system, and then to leave the work of expert inspection chiefly to the railways themselves, where it properly belongs. The practical effect of the other plan is almost to make the State morally responsible for the safety of structures over whose construction it exercises no control.

Transcontinental Lines.

The tenth of the present month was only the eighteenth anniversary of the day when, with much flourish of trumpets and large disregard of the questionable methods under which the work had been done, the first Pacific railway line was declared completed. The word Pacific is now the proper thing to place at the end of the name of any newly projected railway to add a melodious dignity to its title, but instead of the progress of transcontinental lines being a matter of popular interest and knowledge, the work is carried on so quietly that few people know what the companies are which are steadily and rapidly working their way across the continent to the Pacific slope. Last year the Chicago & Northwestern Railroad extended its Fremont, Elkhorn & Missouri Valley line to Fort Fettermann, Wyo. Work has now been resumed west of that point, and the line will be built across Central Wyoming and Southern Idaho, crossing the Union Pacific at Eagle Rock. On the Pacific coast, the Oregon Pacific Railway, which already has 75 miles completed, has let large contracts and is fast locating and building its line across Oregon through the Cascade mountains to Boise City, Idaho. At or near that point the junction will be made with the line from the east, and another company will be ready to declare interstate rates from Chicago to the Pacific.

A little more than a year ago the St. Paul, Minneapolis & Manitoba Railway Co., which operates a network of lines, nearly 2,000 miles in extent, in the fertile wheat regions of Minnesota and Dakota, began building a line west from Devil's Lake, Dakota, a point only 60 miles south of the Canadian boundary, and at the close of the season had laid track to Minot, 527 miles west of St. Paul. This year, as is well known, the line is under construction at an unprecedented rate, and by the end of the season, track will be laid to Butte City, Montana, making over 700 miles of track for the year's record. The route for any further extension is yet to be determined, and the company itself is of course far from avowing any intention of building to the Pacific. But that they will refrain from occupying the rich field of Washington Territory, after having extended so far, seems unlikely. Their probable route is said to be by way of the Sun river through Cadot's pass, crossing the Northern Pacific at Missoula, thence up the Big Blackfoot and St. Regis valleys to the Cœur d'Alene mining country. Should the company push work another season at the same rate as this, its line would be completed before the Northwestern. At any rate these two will probably distance their competitors.

Two other of the great Chicago companies are said to be looking toward the Pacific. The Rock Island is this year showing an astonishing activity, and shows remarkable boldness in building in the very territory of the Santa Fé and Missouri Pacific, a network rivaling their's in extent. Its Pacific extension is already under way through Southwestern Kansas, and will extend, it is said, to El Paso, Tex. Its line to Denver will also be built within a few months, but it seems probable that the southern route will be the one extended to California rather than the Colorado line.

The Chicago, Burlington & Quincy is also said to want a bigger slice of the earth, and by the close of the year will have a large mileage in the mining regions of Colorado and a good hold in Wyoming. It is given the credit of surveys which have been made through Central Utah and Southern Nevada. Should it build by that route, it would have a line from Chicago to San Francisco shorter by far than any now existing.

Considering that the regions west of the Missouri are on an average of far less natural wealth and fertility than those east, the activity now shown in that region is much more notable than that which opened up the immediate Mississippi valley a decade or so ago.

Bags vs. Barrels for Cement.

In continuation of our late editorial on this subject we give some further facts relating to it, and also some explanation of previous statements as suggested by comments called forth and later interviews with those having some actual experience in cement manufacture and transport. As our only purpose is to call serious attention to a practice that seemingly has little else than tradition to support it, we trust that any of our readers having experience, either as manufacturers or consumers, will favor us with their views on what is undoubtedly a question of very considerable financial interest.

We find that the price for a cement barrel, as taken in our last, was not quite correct. An average natural cement barrel costs 22 cts. at the present time; while a Portland cement barrel, made of heavier stock and having usually one iron hoop in addition to more wooden hoops, costs 28 cts. The bag-price given was also low; 5 cts. would buy a very ordinary cotton-bag, but 7 cts. is about as low a sum as it is advisably to invest in such a package to be used only once, owing to the sifting of cement through it.

Messrs. JOHNSON & WILSON, the agents of the American Portland cement, which we have selected for comparison with the English product and practice, tell us that they have fairly tested the bag-package and with very considerable advantage to the consumer. In their practice a strong, tight cotton bag, costing 13 cts. is found to be most economical. This bag holds 95 lbs., or one-fourth of a barrel of their cement, and is charged at this price to the purchaser of the cement, but with the express stipulation that he will be entitled to a rebate of 13 cts. for each bag returned to the cement mill. The wisdom of this policy is apparent, and while the contractor pays for cement only if he takes ordinary care in handling the packages and protecting the bags from injury by hooks, etc., he is made to pay for the negligence of his employés. Bags of the quality here referred to can be thus used over again a number of times and hence are to be preferred to the cheaper type which can only be used once.

In addition to the economy in first cost of package and in space in transport, referred to before, there is an economy in freight charges by getting rid of the dead weight of the barrel. This total economy can be set out in approximate figures as follows: Suppose a purchase of 20,000 barrels of natural cement, and contrast package value at 22 cts. per barrel and freight charges at $1.50 per ton, for example, with the same quantity shipped in 13 cts. bags. Leaving the cost of the cement out of question, as a common factor, we have in the first case 20,000 barrels costing 22 cts. each, or $4,400; these barrels average 20 lbs. apiece in weight, and we must thus add the freight charges on a useless 200 tons of barrels alone, which at $1.50 per ton would be $300. To transport this quantity of cement in bags, on the other hand, would require 80,000 bags, and just here comes in the question of quality in the bags. If the bags were to be used but once and then thrown away, as are the barrels, there would be little if any economy even at the lowest price named. But if good bags are

used and ordinary care is exercised in handling them, so that the contractor can return all but, we will say, 10 per cent. of them, or 8,000 bags in this case, he gets his money back for all the rest and his package expenditure is only 8,000 x 13 cts. = $1,040. But as these bags average about 1½ lbs. each and he is supposed to return them, he has to pay freight upon them in both directions; this amounts to 120 tons, which at $1.50 per ton would amount to $180, or deducting freight on the 8,000 lost bags, $171. On this basis of figuring the contractor saves $3,360 in cost of package, and $120 in freight charges, or a total of $3,480. Taking the ordinary market value of barreled cement at $1.00 per barrel, this saving amounts to nearly 17½ per cent. on the usual price paid, or just 17½ cts. per barrel.

Among the disadvantages of bag-packages, for they do exist, in the risk in rehandling in transport, with a certain wastage of cement at each transfer, and the greater care required to protect the contents of the bags from moisture, especially if a quick-setting cement is in question. Bag-transport is most feasible when the shipment can be made directly from the mill to the consumer without rehandling en route by uninterested parties. And as to exposure to moisture, all cement whether in bags or barrels, is supposed to be well protected and in fact absolutely requires it; though there is no doubt that barrels afford a better protection than bags.

Our statement regarding "fresh-ground" vs. "well-seasoned" cement requires some further explanation. In the first place there is an inherent difference between Portland and natural cements in the effect of long exposure to air after the cement is manufactured, and Portland will stand and actually requires a longer exposure than the natural cements to bring about maximum results. Natural cements can be used with advantage fresh-ground and almost hot from the mill; while Portland cement must be given time to cool, or in other words an opportunity be given to air-slack any particles of quick or free lime contained in it. But Portland cement will not stand too long an exposure or storage if it is intended for hydraulic work. After a certain time it becomes sluggish in its setting qualities, and while its ultimate character may be little effected, it becomes less suitable for hydraulic work, as the cement may be washed out before setting commences.

As an example of what this means, we may mention a case coming under our own notice where American Portland cement (Saylor's was stored for about 5 years at Fort Wadsworth, in New York harbor, and then used because an appropriation was wanting for the purchase of fresh material. The officer in charge reported that at the end of two days the mortar was still very soft, with no approach to the density of a 30 minute set of the same cement fresh; but this mortar gradually hardened, and in some months proved excellent and fully up to the standard in strength. This cement had been stored in a dry casemate, with a free air circulation, but as shown its setting qualities had been much retarded. Natural cements will stand undue exposure and storage still less than the Portland. But as this cement is usually used very soon after manufacture, this condition will not enter into the question of package now under discussion.

As bearing directly upon the question of storage after manufacture, we are indebted to Mr. CHAS. S. CHURCHILL, Prin. Asst. Eng. Penna. Schuylkill Valley R. R. Co., for some notes on cement tests made by him with special reference to the question of age. His method of testing corresponded almost exactly with that adopted by the special committee on cement tests of the American Society of Civil Engineers. In several cases a sample of a particular cement was tested upon delivery, and the remainder, about 2 lbs., put in a paper bag and laid away in a dry closet for 15 days and then again tested. These tests were made with "Improved Anchor" and "Improved Union" brands, both of which he says are "mixtures of a natural and a percentage of Portland cement." The results were as follows:

	Mixture.		Time, to set. Minutes	Time in water. Hours.	Broke at. Pounds.
	Water parts.	Cement parts.			
TEST 150.—Imp. Anchor	3	8	20	24	65
Same cement kept 15 days	2¾	8	60	24	52
TEST 152. — Imp. Union	3	8	20	24	62
Same cement kept 15 days	2¾	8	60	24	52

These tests show that less water was required to mix the cement stored for 15 days; that the stored cement took three times as long to set, and that in this "24 hour" test the strength was reduced some 10 per cent. While this is interesting, we trust that Mr. CHURCHILL will continue his comparison over a longer period of time before breaking the briquettes. These tests show the retardation in setting qualities before referred to as a result of some age, but it is also very possible that, after a longer interval, the loss in strength would be little or none.

Mr. CHURCHILL also describes the practice of bin-storage by the Copley Cement works, and the American Improved Cements Works, both in the same cement region and both manufacturing cements of a very high grade. In these works the cement is stored after manufacture in a series of bins and the time of shipment is usually determined by actual tests of strength. It has been found by test that the peculiarities of different "runs" of cement vary greatly. The general rule is a gain in strength after storage in bins, but the best time for storage varies. Some "runs" cease to gain in strength after a few days, others after a week and still others gain for a month after grinding. Daily tests are now made during storage and as soon as the maximum is reached the cement is shipped.

We hope to be able to give some further remarks on this question of the ageing of cements both for other natural cements and the American and foreign Portlands. Each natural cement rock doubtless has its own peculiar qualities, and as already noted the same rock will turn out widely varying products, according to the behavior of the kilns. The late Mr. D. O. SAYLOR, a pioneer among American cement manufacturers and the first to produce an American Portland cement, says it is impossible to regulate the draught of the kiln so as to burn all the material alike and to a proper degree of calcination; some of it will be under-burnt and thus still contain free lime and other portions will be over-burned and slack into a fine powder on exposure to the air. The remedy he suggests is the selection of the vitrified clinker only from the contents of the kiln and the rejection of all the rest, and the degree of care with which this is done measures to a great extent the comparative excellence of the product.

An objection has been made to bag-packages by paving contractors as being less adapted to temporary storage and transport than is cement in barrels. But as suggested by a prominent cement maker this difficulty can be overcome by the use of a tight covered cement-cart, something like that employed by these same contractors for the transport and storage of tools. Such a cart could be filled from the bags, and hauled to the work as easily as the cement in bags or barrels, and while the cement would always be dry, there would probably be even less wastage than now results from the handling of this same material in barrels.

PERSONAL.

WILLIAM BENJAMIN, a one-time prosperous contractor and ex-alderman of Jersey City, died at his home in that place on May 24.

JOHN C. CLARKE, President of the Illinois Central R. R. Co., has resigned. He will be succeeded by STUYVESANT FISH.

THE Holly Manufacturing Co. has removed its New York office from 44 Broadway to 45 Broadway.

JAMES R. HARDY, Superintendent of the Kansas City, St. Joseph & Council Bluffs R. R. has resigned. He will be succeeded by G. N. HOHL.

BENJ. F. LA RUE, recently Assistant Engineer for the King Iron Bridge & Manufacturing Co., Cleveland, O., has resigned to accept a similar position with the Kansas City Bridge & Iron Co., Kansas City, Mo.

CHARLES PUGSLEY, Principal Assistant Engineer of the New Croton Aqueduct, has resigned his position. Failing health is the cause, and consequent inability to attend to his duties underground.

E. W. MUENSCHER, has resigned the position of City Engineer of Manistee, Mich., to accept the appointment of Chief Engineer of the Chicago, St. Louis & Paducah Ry. Co., with headquarters at Marion, Ill.

HOWARD MURPHY, a Consulting Engineer in practice in Philadelphia and the active Secretary of the Engineers' Club of Philadelphia, has just been confirmed by the Senate of Pennsylvania as a Member of the State Board of Health.

L. H. CLARKE, Chief Engineer of the Lake Shore & Michigan Southern Ry., has resigned his position, but will act as Consulting Engineer. Mr. CLARKE was Chief Engineer for 10 years, and had previously been Chief Engineer of the Illinois Central R. R. for several years. Assistant Engineer T. R. HARDY has been appointed Chief Engineer.

HENRY W. ROGERS has resigned the Superintendency of the Lawrence (Mass.) Water-Works, which position he has held since 1874, in order to accept the management of several systems of works, owned by a Maine syndicate. Mr. ROGERS was formerly Assistant Superintendent of the Salem Water-Works and is at the present time the President of the New England Water-Works Association.

CHANGES OF ADDRESS, MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

R. M. Berrian, Division Engineer. Louisville Southern R. R., Shelbyville, Ky.

Samuel Killebrew, Locating Engineer. Mexican International Ry., Villa Lerdo, Durango, Mexico *via* Eagle Pass.

J. Albert Monroe, Bismarck, Dakota.

B. Frank Richardson, Division Engineer, Baltimore & Ohio R. R., 1531 South 13th street, Philadelphia, Pa.

W. H. Breithaupt, Principal Assistant Engineer on Superstructure, Bridge Department, Chicago, Santa Fé & California Ry., Room 33, Underwriters' Exchange, Kansas City, Mo.

The Burlington Brake Tests.

The tables below give all the more interesting results of the tests, which closed on Monday, May 23, which were not given in our issue of last week. In all 13 days were occupied by the tests, a much less number than last year, owing to the fact that all the competitors but three quickly dropped out while the list of tests was far shorter.

Among the competitors which withdrew were the following:

The Hanscom brake is very simple in construction, having two air tubes running from the pump through the whole train, one connecting with the rear end of the brake cylinder and the other with the front end. The piston is moved back and forth by releasing the compressed air from in front of the piston.

Mr. HANSCOM was present throughout last year's tests, but his studies were not sufficiently successful to enable him to enter his brake in condition to compete on any approach to equal terms, and it was withdrawn after making its first two runs.

The American Brake Co. was not able to enter the tests at all. They have been working night and day for some time, we are informed, to be able to do so, and had expended large sums of money for the purpose, but at the last moment, when their 50 car train was all but ready to leave, found that the cylinders were not tight enough to keep up the pressure properly through a series of stops. They will now proceed to perfect their outfit more at leisure and then propose to make a series of tests of their own.

Their device is an automatic air brake, applied electrically, and with a coupling readily adaptible to couple with the Westinghouse, as will also the Carpenter. No auxiliary reservoir is used and no triple valve, yet there is only one line of hose. The piston is kept in equilibrium by air pressure on each side when the brakes are not in action. By release of the air in front, the air pressure behind applies the brake.

The Card electric brake uses electricity to set in motion a winding gear on the axle which applies the brakes. On its first trip, (run 930) it applied itself on several cars before the stop post was reached. On the middle car it broke the brake chain, and on two other cars it broke the link bolt. There are two link bolts on each car which are in constant motion with the car, and would soon wear out. Some of the cogs on the sprocket wheels for link bolts were also broken on the first trip, and the whole device is such a complicated affair that effective work can hardly be hoped from it, even when new and in best condition. It made another run on Saturday, May 21, and broke several brake chains, and a brake beam, when it withdrew from the contest without any further runs.

The Widdifield & Button (a buffer brake which causes a chain to wind upon the axle, and which made a very unfavorable record last year) write to the *Burlington Hawkeye* that they intended to enter again but could not get their cars together; that they have remedied their difficulties and are making a good record on the Lehigh Valley, where they mean to make some tests shortly.

The Eames Automatic Vacuum brake is much the same as last year in its essentials, except that the brakes are applied electrically. Some improvements have been made from last year, however, and the diagrams of the "foundation brake-gear" which we give herewith will show that they do not appear this year as last with their brake-leverage improperly adjusted, because of absence of a dead lever, so that the pressure on the wheels was unequal. A comparison of the different ways in which electricity has been utilized by the different competitors is interesting, but cannot be made this week.

The Eames Co. have also made an attempt to increase the brake-leverage for loaded cars by a greater movement of a bell crank lever, taking up the slack caused by the shoes being lower down on a loaded car.

This, of course, is a move in the right direction, but ordinary work on freight car gears is so inexact that we fear the device may not be a practical success, although its effects are clearly visible in the much higher per cent. of efficiency of the Eames brake in the mixed car tests. The Carpenter brake has a strong general similarity to the Westinghouse, and it is claimed by the latter that it is in many respects an infringement. This issue was brought to legal test in Germany, where the Carpenter brake is in very extended use, and decided in its favor. Whether the same results will follow in this country is a question which remains to be decided. In many of its minor details the Carpenter differs from the Westinghouse, and in two at least it appears to have had a decided advantage, that it was able to partially relieve the brakes so that its run down hill at 15 miles per hour was at a much more even speed than was possible with the Westinghouse, as is shown in the accompanying diagram, and that its full brake-cylinder pressure was attained more quickly after brakes were applied, which is likewise clear from the diagrams of brake-pressure given herewith. This latter difference accounts for a large part if not the whole of the difference in percentage of efficiency between the two brakes. To what extent this difference is a mere matter of detail and to what extent it is due to legitimate differences of design we are not at present prepared to say. It should be added that the Westinghouse pressure-retaining valve subserves the same purpose as appliances for partial release of brakes and is used very extensively and successfully on the heavy grades of the Colorado and West.

The Westinghouse brake train has the brake gear arranged the same as last year, but proportioned for greater power. The system is improved in several ways. The driver brake has shoes on both side of the drivers, the same as the Eames had last year. The piston rod of the driver brake cylinder has been arranged to go through the upper head, and the air pressure is thus on the bottom of piston, and there is no leakage through the stuffing-box, as with the old driver brake. The pressure is applied at 60 lbs. and after 7 or 8 seconds it is reduced automatically to 40 lbs.

There is a valve on the tender, having a rubber diaphragm in the bottom of the tank, so that the weight of water regulates the pressure on the brake cylinder. If the tank is full the weight of water keeps the valve closed, so that the full 60 lbs. pressure will be applied. When empty the valve is open, and only 40 lbs. can be retained in the cylinder, all above that blowing off. The new triple valve is much quicker in its action than those used last year, as well as otherwise an improvement. Instead of requiring 15 to 17 seconds to apply the brakes on the fiftieth car, it can now be done in 5 seconds. The new engineer's brake valve has also an equalizing arrangement.

The Westinghouse brake has also a device on their driver brake for varying the pressure with the speed, similar to that which was used with such marvellous success in the Westinghouse-Galton tests some eight years ago, where an *average* efficiency of 20 per cent. was realized in stops of an experimental car. The principle is based upon the lower coefficient of friction at high speed. A bell-crank is attached to one of the hangers, the long end of which is held in position by a strong spring, and the spring rod operates a valve which releases the air and reduces the pressure when the brake retardation becomes so great as to endanger slipping the wheels. They can thus carry a high pressure until the speed reduces sufficiently to make enough more friction to give a pull on the bell-crank equal to the strength of the spring and thus open the valve. In this way the pressure is reduced with the speed and no sliding occurs. The Carpenter hose coupling is interchangeable with the Westinghouse and the Carpenter can operate brakes on the Westinghouse cars, though Westinghouse cannot operate Carpenter cars electrically. Carpenter can operate *successfully* only by electricity, if we are correctly informed. Some of the most competent observers at the tests think that there is nothing discouraging about the shocks with the close couplers, for the difference between links and close couplings is more than made up by the suddenness of the stops by the Westinghouse *non*-electric, which still puts on brakes in quick succession from the front, and the impact travels back quicker than the brakes. It is also to be remembered that the value of a close coupler is not alone in breaking, but in the smoother run of the train over sags, when most of the break-aways from links occur, and most shocks due to links are experienced. This was shown conclusively in the late experimental trip through Iowa with a freight train, in April.

The comparative efficiencies of the non-electric stops this year and last year will shed more light on this matter, but this, with all further matter relating to the tests, we are compelled to postpone to another week, for lack of space.

AIR PRESSURE.

In trip 750 of the Carpenter brake, and trip 1,110 of the Westinghouse, the air pressure was as follows:—

		Train pipe on engine.	Rear car reservoir.	Highest in brake cylinders.	Loss of pressure.
		lbs.	lbs.	lbs.	lbs.
Carpenter	1	66	63	20	46
	2	63	65	43	20
	3	60	62½	43	17
	4	51	52	35	16
Westinghouse	1	105	90	59	46
	2	115	102	58	57
	3	115	102	62½	52½
	4	99	90	62½	36¾

It will be seen that the Westinghouse pressures were much higher and the extreme difference of pressure between engine brake pipe and rear car brake cylinder greater.

The weights on braked and unbraked wheels and the percentage of braked weight to total, were given last week. In the mixed trains, two-thirds of the cars (33 out of 50) were loaded with from 42,000 to 48,000 lbs. of car wheels, nearly doubling the total weight of the train while adding nothing to the braking power. This, of course, greatly diminishes the quickness of the stops. The weight in tons of the mixed car trains was as follows:

	Braked.	Total.	P. c. braked wt.
Westinghouse	805 67	1641.32	49.1
Eames	681.48	1399.36	48.6
" (ex way car)	681.48	1379.81	49.5
Carpenter	724.72	1461 00	49 5
" (45 brakes only.)	656.34	1461.00	44.8

The percentage of efficiency in the electric stops with both empty cars and mixed loaded and empty trains is given in the accompanying table. The non-electric stops we must postpone till next week.

PERCENTAGES OF EFFICIENCY OF BRAKES TO TOTAL WEIGHT BRAKED.

Mixed Loaded and Empty 50 car trains.

Brake.		Stop 1.	Stop 2.	Stop 3.	Stop 4.	Average.
Westinghouse	1110	14 0	12.3	10.25	12.93	12.37
	1120	14.0	12.9	10.75	13.42	12.77
	Av.	14.0	12.6	10.5	13 17	12.57
Eames	1202	11.8	11.6	8.88	11.78	11.01
	1240	9.6	10.6	9.20	10.90	10.07
	Av.	10 7	11.1	9.04	11.34	10.54
Carpenter	940	16.5	13.5	11.00	12.20	13.40
	1010	20.0	18.12	12.45	13.90	16.11
	Av.	18.25	15.8	11,72	13.05	14.70
" (Slack b. shoes)		13.25	10.8	7.87	7.60	9.88

Empty 50 Car Trains.

Westinghouse	530	9.75	10.32	6.40	10.8	9 32
	610	10.1	10.10	7.60	10.7	9.62
	Av.	9.92	10.21	7.00	10.75	9.47
Eames	730	7.25	9.0	4.55	8.6	7.35
	740	5.35	....	.....	.....	5.35
	910	4.35	.....	3.35	9.55	5.75
	Av.	5.65	9.0	3.95	9.07	6.53
Carpenter	750	13.55	12.15	9.20	12.3	11.80
	810	12.7	12.7	9.45	11.45	11.57
	820	14.0	13.75	10.00	11.85	12.40
	Av.	13.42	12.87	9.55	11.87	11.97

The very noticeably higher efficiency with the mixed than with the empty car trains, indicates that a very considerable portion of the loading was in fact utilized to increase braking efficiency, by carrying higher pressure or otherwise. The Eames brake have a device expressly designed to utilize the weight of the load for braking purposes, as has the Westinghouse on engine and tender.

The noticeably lower efficiency in stop 3 as compared with the other stop, which is visible in both the above tables, is probably due in great part to a change in the grade of the track just above the stop-post 3, made since the levels on which we have based our computations were taken (which was over a year ago). At least, if this be not the explanation, we are unable to offer any, although we have no information of any such change. Last year there was a rather ugly sag in the grade just preceding the stop-post. If this has been taken out by lifting the track it would make a material difference in the computation, since the "velocity head" due to the speed at that stop is small, and a foot or two more or less, would make a decided difference in the percentage of efficiency. The trains were so short (only one car) in the engine tests that no such change would have a similar effect in their case, and no such discrepancy is visible in the computations of the engine tests which we gave last week.

50 Mixed Car Trains; Electric Stops (33 Loaded, 17 Empty Cars.)

		Stop 1.		Stop 2.		Stop 3.		Stop 4.	
		Speed.	Dist.	Speed.	Dist.	Speed.	Dist.	Speed.	Dist.
Westinghouse	1110	20½	201	31	507	21	241	32	643
" (slack shoes)	1120	20½	201	31½	501	21¾	263	32¾	617
	1350	20¾	201	30⅜	484	21¼	251	33	668
Eames, (no way car attached) 1220 and 1240	1220	19	205	29	462	20	242	30	623
	1240	15	148	31	576	22¾	339	34	872
	1310	20½	314	33	649	21	332	31	721
Carpenter	910	21½	189	34½	572	21¼	228	36½	882
" (45 brakes)	1010	19½	140	30¾	402	22	245	33½	720
" (slack shoes)	1050	20	201	29½	510	21	323	33	1241

The close similarity between runs 1110 and 1120 is very noticeable and extraordinary in the above table.

There was some uncertainty as to the time of the application of the brakes in run 1220, and in run 1240 some of the wheels were greasy, from the fact that there had been some necessary doctoring of a number of hot boxes.

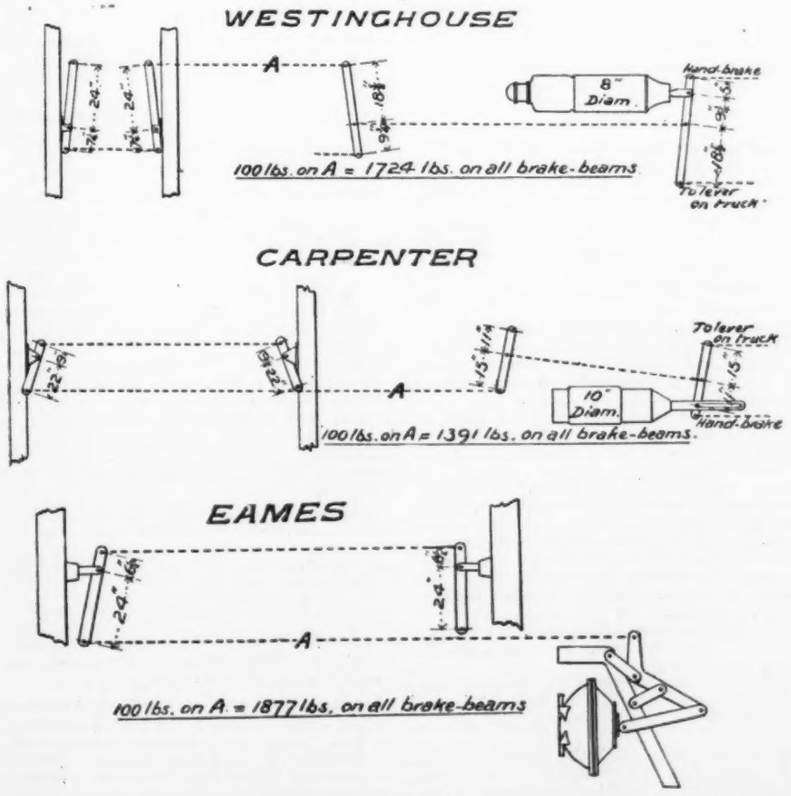
In run 1012 only 45 of the cars had brakes, the brakes on the other 5 having become disarranged.

Runs 1050 and 1350 were made with brake-shoes standing away from the wheels ⅛ to ¾ in. These stops are longer than others with the shoes set close, because the additional slack requires a longer stroke of brake-piston, reducing the pressure in reservoirs more, so that the pump could not keep it up. It is merely a matter of pump capacity, suggesting a larger pump for so long a train, except that such very slack shoes are not a practical necessity. The Westinghouse pump seems to have had ample capacity.

50 Empty Car Trains; Electric Stops.

		Stop 1.		Stop 2.		Stop 3.		Stop 4.	
		Speed.	Dist.	Speed.	Dist.	Speed.	Dist.	Speed.	Dist.
Westinghouse	530	22	181	36½	453	20	170	40½	614
	610	20¾	155	31	475	21	163	42	685
Eames	730	22½	257	40	628	20¼	262	40½	795
	740	21¾	326	electricity	failed.				
	910	20½	352	electricity	failed.	21	425	38½	640
	920	abandoned.							
Carpenter	750	22½	137	32½	308	23	173	41¾	572
	810	23	153	34	324	21½	141	41	597
	820	23	145	36	338	22	139	41	575
Hanscom	840	22	933	30½	1535	22	1412	34½	hand-brakes.
Card	930	broke down and		with-drawn.					
	1210	20	360	36	1050	20½	596	37¼	1698

Run 740, 49 cars. Run 920 of the Eames train was abandoned because of a failure in the electrical apparatus.



The Foundation Brake Gear—Burlington Brake Tests.

The accompanying diagrams show the arrangment of the brake-leverage on each one of the four chief competitors, each of which is theoretically perfect, so as to give the same pressure on every brake-beam. Last year a number of competitors heavily handicapped themselves by neglecting to do this.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(*Specially Communicated.*)

CONTINUED FROM PAGE 337.

Larned, Kan.—The works were commenced April 15, 1887, and are nearly completed; they were designed by J. S. SIMMONS, and J. J. NESBIT is Constructing Engineer. The contractors are R. L. Walker & Co., Wichita, Kan.; the pumping machinery was furnished by the Dean Steam Pump Co., and the pipe, specials, valves and hydrants by the N. O. Nelson Manufacturing Co., St. Louis, Mo.; E. E. Palamer & Son, Kansas City, were the contractors for the stand-pipe, which is 12 ft. diameter by 100 ft. high. The price for trenching and pipe laying was 3 cts. per ft. The franchise is owned by a company in which R. L. Walker & Co., the contractors, are interested; President, N. A. ENGLISH; Secretary, AD. N. JONES. The franchise is for 21 years, and provides for 50 hydrants at an annual rental of $3,000. The present population is estimated at 5,000.

Pennington, N. J.—The works were commenced in November, 1886; the reservoir is completed and two-thirds of the mains laid. The contractor for the works complete is D. A. Clarkson, of Pennington. The size of the stand-pipe is not yet determined on. The trenching and pipe laying are done by day labor. The franchise is owned by the Pennington Spring Water Co.; President and Superintendent, DANIEL A. CLARKSON; Secretary, JOHN G. MUIRHEID. The franchise is perpetual, but the hydrant rental is not yet fixed. The present population is estimated at 700.

East St. Louis, Ill.—The works were commenced in March, 1886, and accepted in December; they were designed by W. S. KUHS, and J. H. PURDY was Constructing Engineer. The contractors for masonry, foundations and buildings, were Nevins & Reimen; for pumping machinery, H. R. Worthington & Co., New York; for pipe and specials, Shickle, Harrison & Howard, St. Louis; for valves and hydrants, Chapman Valve Co., Indian Orchard, Mass., and for the stand-pipe, which is 100 ft. high, T. Wagner. The franchise is owned by the American Water Works & Guarantee Co., Muncie, Ind.; and the works are controlled by the City Water Co. President, CHARLIE THAW; Superintendent, S. M HIGHLAND. The franchise is for 30 years, and the price per hydrant is $100. The present population is estimated at 8,000.

Racine, Wis.—The works were commenced June 1, 1886, and are not yet completed, there being about 6,300 ft. of intake pipe to lay in the lake; they were designed by A. H. HOWLAND, of Boston, Mass., and G. A. ELLIS, of Boston, was Constructing Engineer. The contractors, for the works complete, were Turner, Clark & Rawson, of Boston. The stand-pipe is 25 ft. diameter and 145 ft. high; it is 200 ft. above the lake level. The franchise is owned by the Racine Water Co.; President, HENRY E. COFF, Boston; Secretary, J. E. DODGE; Superintendent, JAMES W. LYON. The franchise is for 25 years and the price per hydrant is $45. The present population is estimated at 20,000.

(TO BE CONTINUED.)

NOTE.—The above statistics of new construction are sent in response to special inquiries sent out by us to contractors, superintendents, engineers and others having to do with new works. We have a special blank for this service, and will be pleased to forward one or more on application. We invite co-operation in this special subject.

CONSTRUCTION NEWS.

Water.

WE have mailed a free copy of Statistical Tables of American Water Works of 1887 to every water-works company, public or private, listed in the Tables: to make sure of their having been received, we notify all those sent to by postal card of our action in the matter, and in a number of cases we have duplicated the sending on account of the first book having been lost in the mails. *If there is a single water-works office in the United States or Canada* where at least one copy of our Statistical Tables cannot be found, we will be obliged for the information. We have also distributed 500 copies among the newspapers of the country and have had nearly as many notices. In a number of cases we have supplied a city council with one or more

copies by request, and it may be assumed that the edition has been very thoroughly distributed "where it will do the most good."

Gas Works.—Plans and specifications for the gas works at Anniston, Ala., are being prepared by J. J. CHILDS, Rome, Ga.——A proposition to build gas works at Greenville, Miss., has been made by Archer Harmon, Louisville, Ky.

Society of Railroad Water Supply Superintendents.—The following officers were elected May 12 at Cedar Rapids, Ia.: Chief Superintendent, A. ROBERTS; Secretary, J. WHITE; Treasurer, W. BENSON. The next meeting will be held at Des Moines, Ia.

Warren, O.—The water-works were tested May 10, with satisfactory results; they were built by Samuel R. Bullock & Co., of New York, and ELLIS MORRISON was Chief Engineer. The stand-pipe is 22 ft. diameter and 140 ft. high, with a capacity of 398,000 galls. A filtering gallery is under construction. There are two Dean, compound, condensing, duplex pumping engines, with a daily capacity of 1,500,000 galls. The supply is drawn from the Mahoning river. The works were accepted May 14.

Janesville, Wis.—No proposals for water works were received May 23 in answer to the advertisement of the Board of Water Commissioners, the Common Council having granted a franchise to Turner, Clark & Rawson, of Boston, and made a contract with them for the construction and operation of the works on May 10. The contract provides for 13 miles of pipe, 180 hydrants, a stand pipe, a storage reservoir of 700,000 galls. capacity, and a supply of artesian water for a rental of $4,200 a year from the city and $25 per hydrant on extensions. Work is to be commenced by June 10 and completed within a year.

The Driven Well Patents Valid.—The U. S. Supreme Court at Washington, on May 23, decided that the patents of Nelson W. Green for driven wells were still valid. The history of this case briefly noted is as follows: In 1861, N. W. GREEN, then Colonel of the 76th N. Y. Volunteers, obtained sub-surface water for his men by first driving a sharp-pointed rod in the ground and then inserting a tube through which the water was drawn by a pump. He and others after him used this device successfully during the war. In 1866 Col. GREEN applied for a patent on his idea, but found that patents had been issued meanwhile to others for a similar device; after a hard legal fight he succeeded in getting control of the patents and a protracted struggle began for the collection of royalties, as the validity of his patents were assailed. In some courts he failed under the charge that he had abandoned his rights, and that in his reissued patents he claimed more than in the original. The court now decides his original patent and the reissue valid, and the legal battle is over. From 500,000 to 1,000,000 driven wells are affected by this decision.

IN the compilation of Statistical Tables of American Water Works, special efforts were made to have them as accurate as possible. Errors have occurred in a few instances which have been brought to our attention, and we especially solicit early information of *any errors* that *any person* may discover, so that they may be corrected. The range of information in future editions will be greatly extended, and we now invite suggestions upon the features most desirable, from water-works officials, engineers, contractors, and parties dealing in machinery and other supplies for water-works. ALL CORRESPONDENCE, ALSO ALL REPORTS, MUST BE ADDRESSED TO ENGINEERING NEWS, TRIBUNE BUILDING, NEW YORK, as future issues will be compiled in this office and under our personal supervision.

Sewerage.—Ware, Mass. The State Board of Health is not satisfied with the plans presented by the town for the new sewerage system, and has asked the road commissioners to furnish plans.——Lowell, Mass. The city will probably soon have to make a large expenditure for an improved sewerage system, to do away with the emptying of the sewerage into Middlesex pond.——St. Cloud, Minn. The City Engineer has estimated the cost of the new sewers at $9,071 ($2.12½ per ft.); of this $2,378 will be paid by the city and the balance by assessment.——Cedar Rapids, Ia. The contractors, Jackson, Doyle & Conners, began work on the Second street sewer May 13; they have 12 miles of sewers to construct this summer.——San Francisco, Cal. It is proposed to engage Col. WARING to report on a sewerage system.——Fresno, Cal. Col. WARING has presented his report to the Trustees. He proposes small sewers for the town with collecting wells from which the sewerage would be pumped to a depositing site, 1¼ miles northwest of the city, where it would be made into compost. The cost is estimated at $50,000——San Luis Obispo, Cal., Col. WARING has made an inspection of the city for a sewerage system and will submit plans.——Glenns Falls, N. Y. Plans for a sewerage system have been prepared by J. W. REED, C. E.——Greenbush, N. Y. Assemblyman RYAN'S bill for the construction of sewers and the appointment of sewer commissioners has passed the State senate.——East Orange, N. J. The sewer work abandoned by contractor Coyle will be relet by the Sewerage Committee, on the recommendation of C. PH. BASSETT, the Engineer.

New Water Works—Bowery Bay, N. Y. Waterworks are being built at Bowery Bay (Long Island) by ROBT. H. SPEARS, for the Bowery Bay Improvement Co.——Little Falls, N. Y. The contractor, M. SULLIVAN, has commenced the trenching and pipe laying.——Saugerties, N. Y. Trenching has been commenced.——Fulton, N. Y. E. R. REDHEAD and CHARLES H. DAVIDS have been appointed a committee by the Village Improvement Society to confer with the water-works company and the village board.——Lebanon, Pa. EDWIN LUDLOW has reported that an abundant supply can be secured at Swedburg, 19 miles distant, at a cost of $275,000 or $350,000.——Wytheville, Va. It has been voted to appropriate $60,000 for water-works and electric light. Capt. J. H. WINGATE has been appointed Engineer in Charge.——Lakeview, Ala. Works will be constructed.——Calera, Ala. The Calera Land Co. will commence the works at once.——Greeenville, Miss. Work will be commenced shortly. Address F. L. BATES, Greenville Water-Works Co.——Rochester, Minn. The works are being pushed by Moffet, Hodgkins & Clark.——Appleton, Wis. A reservoir is to be constructed at once for fire purposes; filters will be put in to purify the river water which will probably be the exclusive source of supply.——Helena, Mont. GEORGE F. WOOLSTON, who owns the franchise, has arrived at Helena and will commence work shortly.——Goderich, Ont. It has been voted to raise $65,000 for water-works and eletric light.

WE will be obliged if every water-works superintendent or engineer, or other official in charge of the distribution of their official printed reports, will see that this office is furnished with a copy of each report issued since 1884, and also give us rates at which water is sold by them. We will be careful to acknowledge receipt of such reports and wherever there are any novel features of importance to the general public, we will be sure to note them in the columns of this journal. Early information also about elections of officers; about extensions of works; the purchase of new machinery and other news of direct interest to parties engaged in the construction and management of water-works is specially solicited. Be careful to address all correspondence to Tribune Building, New York City.

Proposals Open.

Water Works.—For a population of about 1,500. J. J. TRAVERS, Weeping Water, Neb.

Cross Ties.—100,000. H. C. HARRIS, General Manager, Georgia Improvement Co., Atlanta, Ga.

Rubble Stone.—About 1,400 perches of rubble stone for foundation walls for the power house of the cable railway; 16½ cu. ft. to the perch. W. W. DUDLEY, Merchant's Hotel, St. Paul, Minn.

Water-Works.—G. B. HICKMAN, Mayor, Butler, Bates county, Mo. June 1.

Railroad Grading.—Twenty miles, between Sumter Court House and the Santee river. In one lot, or sections of 6 miles. F. GARDNER, Chief Engineer, Manchester & Augusta R. R., Wilmington, N. C. (care of Wilmington & Weldon R. R. Co.). June 1.

Electric Lighting.—Minimum number, 23 lights of 2,000 candle power, on 40 ft. poles. B. H. ROTHWELL Chairman, Fire, Water & Gas Committee, Brantford, Ont., Canada. June 1.

Flagging Sidewalks.—Bids per sq. ft. GEORGE RICHARD CONNER, Commissioner of City Works, Municipal Building, Brooklyn, N. Y. June 1.

Sewers.—GEORGE RICARD CONNER. (*as above*). June 3.

Bridge.—Masonry work, etc., of bridge over Bloody Run. Plans and specifications at the office of the County Commissioners. FRED RAINE, County Auditor. Cincinnati, O. June 4.

Bridges.—Masonry for 3, and iron work for 2 bridges. THE COUNTY COMMISSIONERS, Norristown, Montgomery county, Pa. June 4.

Masonry.—Stone and brick work for superstructure of post office at Lexington, Ky. M. E. BELL, Supervising Architect, Treasury Department, Washington, D. C. June 4.

Bridge Repairs.—Repairing bridge across Bushwick creek at Fourth street. GEORGE RICARD CONNER, Commissioner of City Works, Municipal Building, Brooklyn, N. Y. June 6.

Cement.—Natural 1,800 bls.; Portland, 1,000 bls.; delivered at Lock No. 8, Monongahela river. Lieut. Col. WM. E. MERRILL, U. S. Engineer Office, Cincinnati, O. June 6.

Wooden Bridges.—Two of 1 span each and one of 2 spans; all 20 ft. spans, 16 ft. roadways, pile foundations. CHARLES H. SCOTT, County Clerk, Denver, Col. June 6.

Masonry.—Abutments and wing walls for bridge over Hunt street at McMillan street. THOMAS G. SMITH, President, Board of Public Affairs, Cincinnati, O. June 8.

Sewers and Street Work.—JOHN NEWTON, Commissioner of Public Works, 31 Chambers street, New York City. June 9.

Roadway.—From Danville, Va., to the military cemetary. R. N. BATCHELDER, Dep. Q. M. G., U. S. A., Office of National Cemeteries, Washington, D. C. June 9.

Culvert.—Plans and specifications at the Auditor's office. FRANK J. REINHARD, County Auditor, Columbus, O. June 9.

Materials.—Lime, hydraulic and Portland cement, sand, coal, lumber, firebrick, fire clay, bricks, flagging, 15-in. iron beams, steel, screws, spikes, etc. Col. T. G. BAYLOR, U. S. A., Rock Island Arsenal, Ill. June 10.

Dredging and Rock Excavation.—In Rappahannock river, Va. S. T. ABERT, U. S. Engineer Office, Washington, D. C. June 11.

Dredging.—Dredging and removing ledge in Saco river. Major JARED A. SMITH, U. S. Engineer Office, Portland, Me. June 11.

Pier.—Of stone filled cribs; 90 ft. long. Major S. M. MANSFIELD, U. S. Lighthouse Engineer, Detroit, Mich. June 13.

Court House.—Superstructure of court house at Clarksburg, W. Va. M. E. BELL, Supervising Architect, Treasury Department, Washington, D. C. June 13.

City Work.—Grading; stone block, Hayden block or fire-clay brick pavement; 6-in, Berea curb; trunk sewer, 48-ins., 42-ins., 36-ins. and 24-ins. diameter. R. R. MARBLE, City Engineer, Columbus, O. June 13.

Street Work.—Grading, curbing, guttering and macadamizing; culverts, drains and retaining walls. THOMAS G. SMITH, President, Board of Public Affairs, Cincinnati, O. June 13-14.

Pipe and Specials.—Cast-iron water pipe, 765 tons; specials, 15 tons. LOUIS LESAGE, Superintendent of Water Works, Montreal, Canada. June 14.

City Work.—Sewers; grading and paving with Medina dressed block sandstone. WALTER P. RICE, City Engineer, Cleveland, O. June 16.

Bridge.—Superstructure of high bridge across the Mississippi river at Forbes street and Mohawk avenue, St. Paul. Plans and specifications at the office of the City Engineer. THOS. A. PRENDERGAST, City Clerk, St. Paul, Minn. June 18.

Contracting.

Proposals for Sewers.—In our advertising columns will be found an advertisement for proposals for brick and pipe sewers, with appurtenances, at East Saginaw, Mich.

Dredging.—The following proposals for dredging at the foot of Division avenue were opened May 23, by the Commissioner of City Works, Brooklyn, N. Y.: James DuBois, $1,050; Wm. M. Tebe, $1,100.

Sewer Pipe.—The Board of Public Works, Providence, R. I., has awarded the contract for supplying pipe for 1887, to Henry A. Warner, New Haven, Conn., He had the contract last year, and filled it from Toronto, O.

Pennsylvania, R.R.—Contracts have been awarded as follows: Stone bridge at Johnstown, Sparks & Evans, of Philadelphia; bridge No.10, Little Juniata, E. J. Gaynor, of Pottsville; excavation for the 3 tracks near Mt. Union, P. McManus, of Philadelphia.

Bridge Substructure. — The following proposals have been received for the substructure of the Forbes street bridge at St. Paul, Minn.: Arthur McMullen, $136 119; T. Saulpaugh & Co., $158,832; Charles Lauer, $159, 645.75; Patrick Durack, $175,067; A. J. Jolberg & Son, $197,781.50. The contract was awarded to Arthur McMullen.

Stone Work.—(CORRECTION).—The name of the contractor for improving the Asylum street crossing for the new depot at Hartford, Conn., which was given on page 307 as "M. Beatty," of Leete's Island, Conn., should have been JOHN BEATTIE.

Dallas & Oak Cliff Ry.—Proposals will be received until June 10 at the office of the company, 709 Main street, Dallas, Tex., (where profile and specifications may be seen) for the construction of the road entire or in sections. W. J. STORMS, Secretary.

The Rand Drill Co., of New York, has supplied drilling plants to many of the mining companies in the West. Among others are the following: Montana: Jay Gould Mining Co., Yellowstone Land & Exploring Co.; Kootenay Mining Co.; Judith Basin Mining Co.; Lexington Mining Co.; Granite Mt. Mining Co.; Drum Lummon mine; Anaconda mine, etc. Utah: Christy Mining Co; Eureka Hill Mining Co.; Daly and Ontario mine; Eclipse mine. Oregon; Seven Devils Mining Co. Plants have also been supplied to Manitoba mines, and to the Zacatecas Mining Co. and Botello Mining Co. in Mexico.

Sewerage System.—The following proposals were opened May 17 by the Sewerage Commission, Corning, N. Y., for the construction of a system of sewers, in accordance with plans and specifications prepared by C. PH. BASSETT, of Newark, N. J., the Engineer-in-Charge. The work includes about 13 miles of vitrified, salt glazed, stoneware sewer pipes, of spigot and socket pattern, in the following quantities: 6-in., 30,000 ft.; 8-in., 20,000 ft.; 9-in., 9,500 ft.; 10-in., 8,500 ft.; 12-in., 2,200 ft.; 15-in., 500 ft.; 18-in., 2,300 ft.; 24-in., 560 ft.; 30-in. by 46-in., 1,000 ft.; there will also be 63 basins, 46 half basins, 26 flush tanks, 47 special manholes and 190 common manholes:—

BIDDERS.	Excavating trench, furnishing materials, constructing, back filling, etc., outfall storm water sewer, 30 ins. by 46 ins. Per lin. ft.	Ditto for 24-in. storm-water sewer in First St. Per lin. ft.	Ditto for 18-in. storm-water sewer in First St. Per lin. ft.	Ditto for 15-in. storm-water sewer in First St. Per lin. ft.	Ditto for 12-in. storm-water sewers as located. Per lin. ft.	Do. for 10-in. outfall sewer through Second St. Per lin. ft.	Do. for 9-in. outfall sewer through Second St. Per lin. ft.	Do. for 18-in. outfall sewer through Second St. Per lin. ft.	Ditto for 12 in sewer in Mill St. Per lin. ft.	Ditto for 10-in. sewers as located. Per lin. ft.	Ditto for 9-in. sewers as located. Per lin. ft.	Ditto for 8-in. sewers as located. Per lin. ft.	Ditto for 6-in. sewers as located. Per lin. ft.	Special manholes, including all materials & labor. Per vertical ft.	Ordinary manholes, including all materials & labor. Per vertical ft.	Basins, including all materials and labor. Per vertical ft.	Flush tanks, complete. Each.	Half-basins, complete. Each.	Iron work in place. Per pound.
	$	$	$	$	$	$	cts.	$	$	$	$	$	cts.	$	$	$	$	$	cts.
W. H. Bray, Mine Hill, N. J.	5.50	2.75	1.83	1.35	1.11	.91	84	1.83	1.11	.91	.84	.72	65	7.50	6.25	7.50	37.50	50.00	5
Stanton & Coyle, Cohoes, N. Y.	5.48	2.08	1.22	.98	.74	.64	59	1.86	1.07	.84	.82	.55	45	4.50	4.00	4.50	40.00	8.00	4
Jones & Ellsworth, Rochester, N. Y.	4.75	2.15	1.30	1.08	.80	.75	70	1.40	.85	.80	.70	.65	40	5.00	4.00	7.00	75.00	20.00	5
J. McDougall, Son & Co., Hornellsville, N. Y.	4.38	1.79½	1.00½	.76¼	.55½	.45½	39½	1.09¼	.61¼	.50¾	.42¼	.37½	28½	5.00	4.50	5.50	28.00	12.00	2½
Jas. & R. H. Walker, Elmira, N. Y.	6.29	2.05	1.26	.95	.73	.58	52	1.26	.73	.58	.52	.43	34	3.17	3.17	6.00	21.50	10.64	7
T. Newman and F. A. Snow, Providence, R. I.	6.75	2.55	1.50	1.18	1.13	1.00	86	1.90	1.75	1.15	1.15	1.05	85	5.20	5.10	6.70	52.00	16.00	3½
Doremus & Staats, New York City.	4.68	1.75	1.15	.85	.60	.51	45	1.26	.77	.69	.57	.44	34	4.33	4.00	6.29	36.00	9.00	2½
Hingston & Drew, Buffalo, N. Y.	4.85	2.10	1.20	.97	.69	.58	53	1.29	.83	.61	.56	.47	38	5.00	4.40	4.35	30.00	13.00	3
Brown & Buckley, Mohawk, N. Y.	6.15	2.08	1.27	1.03	.82	.71	68	1.27	.82	.71	.67	.62	54	5.07	4.06	8.00	35.00	24.00	3½
Clark & Byron, New York City	5.00	2.85	1.71	1.43	1.19	.90	86	1.71	1.19	.90	.85	.75	60	2.50	2.35	15.00	60.00	25.00	5
W. E. Dean, New York City.	5.50	2.30	1.50	1.30	.60	.53	45	1.23	.57	.51	.47	.43	37	4.50	3.00	7.50	30.00	15.00	3
John Cannon & P. Marray, Elmira, N. Y.	6.00	1.95	1.13	.86	.68	.60½	51¾	1.13	.68	.60½	.51¾	.44½	32	4.00	3.00	3.00	10.00	12.00	3
Griffith & Gorton, Corning, N. Y.	3.25	1.83	1.10	.83	.68	.58	48	1.10	.73	.60	.50	.48	39	3.50	4.33	6.77	34.25	15.25	2
Geo. B. Allen & D. W. McConnell, Buffalo, N. Y.	4.40	1.79	1.15¼	.96	.64	.54½	49½	1.20	.70	.54½	.49½	.49	44	3.90	3.70	3.50	33.00	25.00	3

Pumping Engine.—The contract for a pumping engine has been awarded by the Water Commissioners, Asbury Park, N. J., to the Holly Manufacturing Co., of Lockport, N. Y., for $1,700. The only other bid was from the Deane Steam Pump Co., of Holyoke, Mass.

Centrifugal Pumping Engine.—The following proposals were opened May 18, by WM. LUDLOW, Engineer Commissioner, Washington, D. C., for furnishing 1 No. 4 centrifugal pumping engine: S. C. Forsaith Machine Co., Manchester, N. H., $740; J. Edwards & Co., New York, $1,070.45; Lawrence Machine Co., Boston, $1,425.

Lighthouse.—The following proposals for the metal work for Pipe Island lighthouse were opened May 21, by Major S. M. MANSFIELD, U. S. Lighthouse Engineer, Detroit, Mich.: Russell Wheel & Foundry Co., Detroit, $1,178; Phœnix Iron Co., Trenton, N. J., $1,500; Colwell Iron Works, New York, $1,700; H. A. Ramsey & Son, Baltimore, Md., $1,895.

Iron Work, Etc.—The Board of Improvements, Cleveland, O., has awarded the following contracts for the north approach to the Kingsbury Run viaduct: trestle work, $6,826.52; hand rail, Manly & Cooper Manufacturing Co., Philadelphia, Pa., $25,500; embankment, Frank Reiley, $4,600; curbing and crosswalks, $964.50.

Improved Rock Breaker.—The Farrel Foundry & Machine Co., Ansonia, Conn., manufacturers of the "Blake" rock breaker, have patented an adjustable toggle block by means of which the length of the stroke can be adjusted while the machine is in motion. S. L. MARSDEN, the Superintendent, says the machine as now constructed has no equal.

Ballast and Crushed Stone.—The following proposals have been received by JOHN W. MCDONALD, Superintendent of Streets, Boston, Mass.: Owen Nawn, ballast, $1.30; crushed stone, $2.25; Putterill & Killian, $1.37, $1.83; Hugh Nawn, $1.44, $2.50; David Hall, $1.98, $2.35; Donnan & Tileston, ballast, $1.75; Timothy McCarthy, ballast, $2.27.

Iron and Steel.—The following proposals for steel and iron for lock gates and filling valves for La Grange lock, Illinois river, were opened May 20 by Major THOS. H. HANDBURY, U. S. Engineer Office, Chicago, Ill.: Williams, White & Co., Moline, Ill.; steel, 43,000 pounds, 5.4 cts. per pound; wrought-iron, 17,500 pounds, 3.9 cts. per pound: cast-iron, 110,000 pounds, 4.8 cts. Builders' Iron Foundry, Providence, R. I., 6.87, 5.45 and 5.45 cts. per pound. Vierling, McDonald & Co., Chicago, Ill., 6.5, 9 and 6.25 cts.

Street Improvement.—The following proposals for improving about 7 miles of streets, with curbs, gutters, sidewalks and roadway pavements, have been received by WM. LUDLOW, Engineer Commissioner, Washington, D. C.: Barber Asphalt Co., coal tar distillate pavement, $1.98 and $2 per sq. yd.; H. L. Cranford, same material, $1.98 and $2 per sq. yd.; P. Maloney, asphalt block pavement, $2 per sq. yds. Each party bid for grading 25 cts. per cu. yd., and for hauling, 1 ct. per 100 ft. over 200 ft.

Sewers.—Proposals received May 18 by WM. LUDLOW, Engineer Commissioner, Washington, D. C., for constructing pipe and brick sewers, ranged as follows: Pipe: 12-in., 77 to 95 cts.; 15-in., 81 cts. to $1.20; 18-in., 87 cts. to $1.40; 20-in., 97 cts. to $1.50; 24-in., $1.09 to $1.75: Brick: 4½ by 6¾ ft., $4.57 to $9; 3½ by 5¼, $3.91 to $7; 3 by 4½, $3.65 to $5.60; 2¼ by 4½, $3.53 to $5.50; 2¼ by 3¾, $3.18 and $5.20; 2¼ by 3¾ $3 and $5.25; receiving basins, $47.75 to $70; 6-in. pipe connections, 23 to 75 cts.

Breakwater.—The contract for the construction of a breakwater at Agate bay has been awarded by Capt. J. W. QUINN, U. S. Engineer Office, Duluth, Minn., to Steele Bros. & Co., of Duluth, for $18,948. The breakwater will be 400 ft. long and will consist of a foundation of riprap and crib work filled with stone; the superstructure will be 6 ft. above the water. The work is to be completed by December.

Fire Apparatus.—The following proposals were opened May 23, by JOHN ENNIS, Commissioner of the Fire Department, Brooklyn, N. Y.: One second size piston steam fire engine, La France Fire Engine Co., Elmira, N. Y., $4,500; one Hayes ladder truck and fire escape, La France Fire Engine Co., $3,000; one second size steam fire engine, Clapp & Jones Manufacturing Co., Hudson, N. Y. $4,500.

The Continental Iron Works is the name of the company which has taken over the Continental Iron Works, of THOMAS F. ROWLAND, at Brooklyn, N. Y. The works cover about 4 acres of land and have the most extensive water front in the neighborhood of New York. The new company will continue the manufacture of gas-holders and heavy special machinery. President, THOS. F. ROWLAND; Vice-Presidents, WARREN E. HILL and CHAS. H. CORBETT: Secretary and Treasurer, THOS. F. ROWLAND, Jr.

Vicksburg Sewerage.—H. ST. L. COPPEE, C. E., in a letter to the Vicksburg *Commercial Herald*, strongly advocates the construction of a proper system of sewerage in that town, and says the very early completion of the water-works now under construction will make sewerage a necessity. He favors the Waring system, and estimates that a satisfactory result could be obtained by an expenditure of about $50,000, while the estimates for the combined system run up to $400,000.

Paving and Sewers.—The following contracts were awarded May 19 by the Commissioner of Public Works, New York City: (1) Regulating and trap block paving on William street; P. H. McCullock; pavement, $2.15 per sq. yd.; bridge stone, 60 cts. per sq. ft.; total $2,302.80. (2) Sewer on Avenue B; Wm. F. Cunningham, sewer, $5.90 per ft.; timber, $40 per 1,000 ft. B. M.; total $2,273.50. (3) Sewer on Attorney street; Jos. Moore, sewer, $6; timber, $40; total, $1,938.

Dumping Board.—The following proposals for a dumping board and approach at 80th street, East river, were opened May 20 at the Department of Docks, New York City: W. Danforth, $2,395; O'Connell & Coffey, $2,750; John S. Walsh, $2,973; Fearon & Jenks, $4,500' The contract was awarded to W. Danforth. The work includes about 9,200 cu. ft. of round log crib work, 28,522 ft. B. M. of yellow pine timber; piles, iron straps, bolts, spikes, etc.

Sea Wall.—The contract for building 1,000 ft. of seawall has been awarded by the Harbor Commissioners, San Francisco, Cal., to J. S. Tibbals at the following prices: 112,400 tons of rock, 68 cts. per ton, $76,432; 88,900 cu. yds. of earth, 33½ cts. per cu. yd., $29,633.33; 60,000 sq. ft. of wharf, $22,500; total, $128,565.33. The other bidders were: M. J. Kelly, $134,970; Pacific Bridge Co., $141,127; San Francisco Bridge Co., $148,100; Kelsoe & Baldwin, $151,119; C. A. Warren, $153,588; J. H. Burrell, $153,839.50; Thomas Thomson, $160,720. The estimate of MARSDEN MANSON, Engineer to the Harbor Commissioners, was $134,964.

Lighthouse Work.—The following proposals were opened May 20, by Capt. J. C MALLERY, U. S. Lighthouse Engineer, Philadelphia, Pa.: For constructing frame lighthouse tower, etc., near Billingsport, N. J.: Thos. G. Locke, Wilmington, Del., $1,424; Hughes & Hand, Cape May City, $1,677.14; John C. Kelley, Philadelphia, $2,195; Theo. M. Keeney, Philadelphia, $2,360; Pettit & Boon, Philadelphia, $2,385; J. R. D. Leeds & Son, Wilmington, Del., $2,721; Robt. P. Mattson & Co., Philadelphia, $4,350.—For alterations to lantern at Cape Henlopen, Del.: Manly & Cooper Manufacturing Co., Philadelphia, $1,950; Phœnix Iron Co., Trenton, N. J., $1,997.

Chicago, St. Louis & Paducah Ry.—The contract for the grading and bridging of the first division, 13 miles, from Marion, Ill., to the Cairo, Vincennes & Chicago R. R. near New Burnside, has been awarded to N. W. Irish, of Carlyle, Ill., at the following prices: (the prices in brackets represents the highest and lowest prices of the several bids): Clearing and grubbing, $17 ($17 to $60); earth hauled within 1,000 ft., 18 cts. per cu. yd. (16 to 27 cts.); earth wasted, 13 cts. per cu. yd. (13 to 22 cts.); earth borrowed, 13 cts. (13 to 16 cts.); earth under water, extra, 58 cts. per cu. yd. (43 cts. to $1); solid rock, extra, 77 cts. per cu. yd. (60 cts. to $1); loose rock, extra, 46 cts. (20 to 75 cts.); bridge masonry, $9.75 per cu. yd. ($7.70 to $10); culvert masonry, $5.90 ($4.50 to $8); stone arch masonry, $8.40 ($4.50 to $11.50); brick masonry, $10.20 ($6 to $14); coping, $14; paving and slope walls, $3.75 ($1.50 to $3.75); concrete, $4.50 ($3 to $6.35); laying 12-in. pipe culverts, 39 cts. per ft. (30 cts. to $1.15); laying 15-in. pipe culverts, 46 cts. (35 cts. to $1.15); framing and raising framed trestles, $9 per 1,000 ft. B. M. ($6.50 to $23); pile trestles, $9 ($9 to $23); driving piles, 12 cts. per ft. (12 to 40 cts.). In the district where the line runs, timber for trestles is worth $12.50 per 1,000 ft. B. M.; telegraph poles, 60 cts. each; cross ties, 26 cts. each; piles 6 to 13 cts. per ft. according to length.

City Work at St. Louis, Mo.—The following proposals were opened May 10, by the Board of Public Improvements, St. Louis, Mo.: Iron work of the south viaduct of the Grand avenue bridge, between approach and anchor pier; (460,000 lbs.) St. Louis Bridge & Iron Co., $18,775; Wrought Iron Bridge Co., $19,950; Keystone Bridge Co., $20,200; Stupp Bros., $23,000.

Improving Washington avenue; L. Schmalz, taking up old paving, etc., and preparing road bed, $5 per 100 sq. ft., $3,535; new 4-in. curbing, set, 85 cts. per lin. ft., $2,720: old curb taken up and reset, 20 cts. per lin. ft., $90; 6-in. hydraulic cement concrete, laid, $10 per square of 100 sup. ft., $7,070; paving of pine blocks impregnated with chloride of zinc, $23 per sq., $16,261; maintenance, 5 cts. per sq. per annum, $318.15; total, $29,994.15. Fred Skrainka, $6, $4,242; 75 cts., $2,400; 1 ct., $4.50; $10, $7070: $19.50, $13,786; 50 cts., $3,181.50; $30,684.15. Allen & Vieths, $5, $3,535; 80 cts., $2,560, 15 cts., $67.50; $10, $7,070; $21.45, $15,165.15; 50 cts., $3,181.50; $31,579.15.

For grading, curbing and granite block paving on certain streets, bids were received from Fred Skrainka, G. Eyermann, Stifel & Buckert, Julius A. Schneider, John B. O'Meara, and Allen & Vieths. The prices ranged as follows: Grading, 38 to 75 cts.; curbing, 70 to 85 cts.; 8-in. hydraulic cement concrete, $7 to $10; granite block paving, $26.25 to $34. The bid of F. Skrainka was the lowest in each case.

Grading on Eads avenue: Michael Harrick, 14½ cts.; Patrick Berney, 14¾ cts.; John Beiswaenger, 15½ cts.; Ed. W. Whittler, 17¾ cts.; B. Bartnat and P. McGynn 27¾ cts.

Railroads.

New Companies & Projects.—*East of Chicago.*—Penobscot R. R. Co. The incorporators of this Maine line have elected as President., JOHN MORRISON of Corinth, Me.——Manayunk Branch R. R. Co. Chartered in Pennsylvania to build a line on the East bank of the Schuylkill river in Manayunk and vicinity to accomodate manufacturing interests. The line will be four miles in length and will connect with the Reading and Pennsylvania lines. WM. W. HARDING is president.——The Hartford & Harlem Railroad Company whose line has so long been in a projected state, has been granted three years extension of time in which to comply with its charter requirements, provided that not less than $500,000 is expended in construction by Dec. 30, 1888.——Eastern Shore R. R. The route of this proposed Maryland line from Easton, Talbot Co., to Salisbury, Wicomico Co., is under examination this week by committees from Baltimore business associations. President JOS. B. SETH conducts the trip.——Pennsylvania R. R. The Kansas City *Times* reasons as follows: the company has recently increased its capital stock $8,000,000. It would cost about that sum to build an extension to Kansas City. Therefore the Kansas City extension may be expected.——New York & New England Ry. A recent Wall Street rumor located an extension by this company to the New York City limits, from which point running arrangements were to be made with the Manhattan Elevated Company.——Iberville, Durham & Clarenceville Ry. Co. This Canadian company has been incorporated.——New Haven & Derby R. R. Another offer has been made to the city of New Haven, Conn., for its interest in this line by W. H. STARBUCK, who agrees, if his offer is accepted, to extend the line to Hawleyville.

Southern.—Northeastern R. R. of Georgia. The extension from Tallulah Falls, Ga., to Maryville, Tenn., which Hon. W. B. THOMAS of Athens, Ga., proposes to build, is arousing much interest in the towns along the proposed route, and it is thought that enough subscriptions can be obtained to warrant the commencement of work.——Birmingham & Atlantic Air Line R. R. The directors have voted to build a branch line from Greenville, Ga., to Savannah, via Thomaston, Macon and Dublin, about 220 miles.——Nottingham R. R. & Improvement Co. Organized by T. REYNOLDS and others, Selma, Ala., to build a blast furnace and narrow gauge railroad.——Florida Southern R. R. It is stated that a branch will be built to Bay Port, on the Gulf.——Key of the Gulf R. R. Co. is the name of a newly organized scheme in Florida.——Tennessee Central & Alabama R. R. Organized to build a line from Trenton, Tenn., to Florence, Ala.——Eufaula & Southeast Alabama R. R. Incorporated by J. W. TULLIS, of Eufaula, Ala., to build a railroad in Alabama from Clayton to Blakely, with a branch to Geneva.——South Alabama R. R. Co. Organized in the interest of the Central R. R. Co. of Georgia to build from Columbia to Mobile.

The Northwest.—Illinois Central R. R. The Freeport, Dodgeville & Northern R. R. Co. has been incorporated in this interest, to build a line from Cadiz, Greene Co., Wis., on the Chicago, Madison & Northern R. R., to Dodgeville, a distance of 40 miles.——Northern & Eastern Midland R. R. Co. Incorporated by WM. TURNER, of Chicago and others, to build a line in Illinois from Kankakee to Joliet.——Chippewa Falls & Ashland Ry. Co. Chartered in Wisconsin by T. C. POUND and others to build a line, 130 miles in length, between the cities named.——A narrow gauge railroad is projected in Western Dakota from Rapid City to Brownsville.——Manitoba railway schemes seem to be the cause of much contention. HUGH SUTHERLAND, president of the Hudson Bay Ry. Co., is endeavoring to obtain a good sized Government subsidy in aid of his project, a scheme of disposing of the Canadian surplus which the provincial Government is fighting tooth and nail. It is however strongly in favor of chartering lines to the boundary to compete with the Canadian Pacific's present monopoly, an idea which finds little favor with the Dominion Government and still less at the offices of the great Canadian railway. Sir GEORGE STEPHEN has warned Premier NORQUAY that if "mischievous agitation" and "persistency in regarding the Canadian Pacific as a public enemy" is persisted in, the railroad shops will be established at Fort William and a direct line will be built from Selkirk to Portage La Prairie. Another friendly offer of the Canadian Pacific in another quarter is that if the Michigan Central does not grant them trackage facilities for a line to Chicago, a line will be built this season from St. Thomas to Windsor.——Chicago, Rock Island & Pacific Ry. It is stated that this company will build a line this year from Beatrice, Nebraska to Avoca, Ia., via Nebraska City and Carson.——Atchison, Topeka & Santa Fé Ry. Rumors of an Omaha extension continue to be affirmed and denied. It is also said that the company has offered to build to Lincoln for "a moderate consideration."

The Southwest.—Fort Scott Belt Line R. R. Co. Incorporated at Fort Scott, Kan., by U. B. PEARSALL and others.——Texas Trunk R. R. Efforts are being made for an extension from Cedar to Palestine.——Houston & Texas Central R. R. It is said that an extension will be built from the present terminus at Albany, Tex. A company is organizing at Arcadia, La., to build a railroad from Alexandria to Fort Smith, Ark. Hon. A. L. ATKINS of Arcadia is interested.——A line is proposed in Northwestern Missouri from a point near Lanning's Mill, on the Chicago, St. Paul & Kansas City extension now under construction, to Brownsville, Neb., *via* Maryville, Quitman, Tarkio and Rockport. JOHN S. BILBY of Quitman is interested.——Randolph Belt R. R. Co. Incorporated by M. S. POTTS of Kansas City, and others to build a belt line at Randolph, Clay Co., Kan.——St. Louis & San Francisco Ry. The strong rivalry between this company and the Missouri Pacific seems to be in no danger of any decrease. The main battle ground lately has been in the country between Little Rock and Fort Smith, Ark. There was an exciting race some time ago, for the possession of the mountain pass known as Tomlinson's Gap; and while the Gould party reached there first, their opponents were undaunted and located their line on the other side of the creek. At present the prospects seem favorable for an active rivalry in Missouri. The St. Louis & Western Ry. was sold at auction recently. The line consisted of a franchise for a road from Laclede, Mo., to Fort Scott and six branches, with only a short section of graded line. The representative of the Missouri Pacific who was present warned the bidders that the buyer would be investing in a lawsuit, but the property was sold to the St. Louis & San Francisco company for $30,000.——A proposed line in Missouri begins at Bowling Green, Pike Co., and runs *via* New Florence, Herman, Rolla, and Willow Springs toward Little Rock, Ark.

Rocky Mountain and Pacific.—Montana & Cœur d'Alene R. R. Co. Incorporated by G. W. GRIGGS and others of St. Paul, Minn., to build a line from some point on the Northern Pacific near Thompson Falls, to the Cœur d'Alene mines.——Missouri Pacific Ry. Monte Vista, Col., wishes the line to be extended to that place instead of terminating at Pueblo.——Denver, Utah & Pacific Ry. The proposed extension from Longmont, Col., to Laramie City, Wyo., is causing much excitement. The citizens of Denver, Laramie, Fort Collins, and other places are willing to subscribe heavily in aid of the line and its construction seems very probable.——Atchison, Topeka & Santa Fé R. R. Articles of incorporation have been filed for the New Mexico Central R. R. Co., to build 1,680 miles of railroad in the Territory, consisting of four main lines and ten branches. $1,685,000 of capital stock has been subscribed, and ten per cent. paid to E. WILDER, Treasurer.

Surveys.—*Southern.*—It is reported that a consolidation, more or less complete, has been effected of the Birmingham, Georgia & Florida R. R. Co., and the Macon, La Grange & Birmingham R. R. Co. The former now owns the partly graded roadbed of the Bainbridge, Cuthbert & Columbus R. R., and has begun surveys upon it with a view to early completion.——Cincinnati, Huntsville & Birmingham R. R. The line of this road is to extend from some point on the Cincinnati Southern R. R., near Somerset, Ky., *via* Tullahoma or Shelbyville, Tenn., and Huntsville, Ala., to Birmingham. The line has been located from Leeman's Ferry to the Tennessee State line, and the engineers are now working north from that point. The survey will be completed by July 1, and contracts will then be let. WM. RICHARDSON, Huntsville, Ala., is President, and A. G. NEGLEY is Chief Engineer.——Warrior Coal Fields R. R. Co. A survey is in progress for this line which is to extend from Meridian, Miss., to Narkeeta. J. W. GALLUP is Chief Engineer.——Louisville & Nashville R. R. On the extension to connect with the Norfolk & Western R. R., the engineers have finished a survey of the Pennington Gap route, and are now at work on a line *via* Cumberland Gap. It is also rumored that Richmond & Danville surveyors are working on a line to Cumberland Gap.——Ohio Valley R. R. A survey is in progress from Princeton, Ky., to Florence, Ala.

The Northwest.—Jacksonville & Southeastern R. R. Surveyors are at work on a 20 mile extension from Centralia, Ill., to Mt. Vernon.——Springfield, Shelbyville & Mt. Carmel R. R. The preliminary survey of this Illinois line is just completed.——St. Louis, Alton & Terre Haute Ry. The extension from Marion Ill., to Paducah, Ky., for which preliminary lines were run in March, is now assured by the voting of $100,000 by Paducah, and the final location is under way. The extension will be known as the Chicago, St. Louis & Paducah Ry. At the same election a like sum was voted to the Mt. Vernon & Paducah R. R. Co. of which E. A. QUINTARD is President.

The Southwest.—San Antonio & Aransas Pass Ry. The company has contracted to extend their line to Flatonia, Tex., and expects to run trains to that place by Sept. 1. This is the first town of importance on the Waco extension, which will probably be pushed beyond Flatonia at an early date.——Missouri Pacific Ry. On the line from Ft. Smith, Ark., to Gurdon, the surveyors are working near Danville.

The Chicag , St. Lo is & Paducah Railway Co. was organized a few weeks ago to build a railroad from Marion, Ill., to Paducah, Ky., as an extension of the Marion Division of the Cairo Short Line. Hon. WM. K. MURPHY, of Murphysboro, Ill., is President, GEO. W. PARKER, of St. Louis, Mo., General Manager, and Col. E. W. MUENSCHER, formerly City Engineer of Grand Rapids and Manistee, Mich., is Chief Engineer. The company has abundant means, and the city of Paducah has voted a subsidy of $1 0,000 to the road, which insures its completion during 1888. The first division, 15 miles in length, extending from Marion to a point on the Cairo, Vincennes & Chicago Railroad, 1¼ miles south west from New Burnside, is located and the contract for the grading and bridging of this division was awarded May 13, to N. W. Irish, of Carlyle, Ill., to be completed by Oct. 15. The Chief Engineer with a full corps of assistants has taken the field again to locate an additional division of 10 miles which will cross the Ozark Range the most difficult portion of the State of Illinois, where very careful engineering will be required to obtain a route combining economy of construction with easy grades and curvature. If necessary for this purpose two or three months will be spent on this division.

Cable Railways.—Pittsburg, Pa. The Citizens' Passenger Ry. Co. proposes to adopt a cable system. JOHN G. HOLMES is president.——St. Joseph, Mo. An ordinance for a cable line, 5 miles long, has been granted to JAMES LILLIS and WM. T. JOHNSON, of Kansas City. Work will be begun at once.——St. Louis, Mo. A contract for the complete construction of a cable line on Olive street has been awarded to Wright, Mysenberg & Co. Eastern firms are competing for the iron work.——Kansas City, Mo. The Metropolitan Cable Co. has purchased from the National Cable Ry. Co., of New York, all its patent rights for Kansas City and Wyandotte county.——Milwaukee, Wis. A cable railway is projected to Wauwatosa. RUDOLPH NUNNEMACHER is one of the promoters.——Lincoln, Neb. The Lincoln Cable Ry. Co. has been incorporated by J. H. AMES and others, with a capital stock of $500,000.——Omaha, Neb. The Metropolitan Cable Ry. Co. has been incorporated by F. L. UNDERWOOD and others, with a capital stock of $1,000,000.——Denver, Col. The Denver Cable Ry. Co. has elected the following officers: President; J. E. BATES, Vice President and Chief Engineer, J. M. THOMPSON; Secretary, OWEN E. LA FEVRE; Superintendent and General Manager, JAMES MCCORD.——San Francisco, Cal. Work has been commenced on the construction of the Castro street cable line. New machinery has been erected for the California street line, and the speed has been increased, making this the fastest cable line in the city.

Bridges, Canals, Etc.

Fort Madison Bridge.—The Mississippi River Railroad & Toll Bridge Co. is constructing a highway and railroad bridge at Fort Madison, Ia. Its total length is 1,925 ft. and it consists of 8 spans, including a draw span of 400 ft. O. CHANUTE, of Kansas City, Mo., is Chief Engineer and W. W. CURTIS, of St. Paul, is Resident Engineer. Sooysmith & Co. are the contractors for the substructure and the first pile was driven March 15. The Union Bridge Co., New York, has the contract for the superstructure and it is to be completed in the fall. The pivot pier, No. 4, is the only one yet ready for the superstructure but Nos. 1, 2 and 3 will be ready by the middle of June; Nos. 5 and 6 are to be sunk by pneumatic caissons, and the caisson for No. 6 is now in position; work has also been commenced on Nos. 9 and 10. The bridge will carry the track of the Chicago, Santa Fé & California R. R.

Bridge Notes.—(*New York*). Poughkeepsie. The bill extending the time for completion of the Poughkeepsie bridge across the Hudson has been passed by the State Legislature.——Utica. The Utica, Clinton & Binghamton R. R. will cross the Utica, Chenango & Susquehanna Valley R. R. on an iron girder and truss bridge with 3 spans, 72, 93 and 95 ft., and an elevation of 20 ft. A riveted lattice lift bridge will be built across the canal at John street; C. S. JOHNSON, Resident Engineer of the Eastern division of the Erie canal, is making the surveys of the site.——(*Pennsylvania*). Norristown. An iron bridge is to be built across Saw Mill run at Airy street. Address A. W. CORSON, Borough Surveyor.——(*Georgia*). Macon. A bridge is to be built across the Ocmulgee river at Second street, at a cost of about $30,000. It will be built by the county.——(*Minnesota*). St. Paul. Plans have been prepared by the City Engineer for the Franklin avenue bridge; there will be 4 spans of 175 ft. and a center span of 302 ft., with 93 ft. headway, or 63 ft. if a lock and dam are constructed. An alternative plan is for a cantilever span of 400 ft.

ENGINEERING NEWS

THE preliminary work in connection with the Halifax Graving Dock has been steadily progressing since May, 1886. The coffer dam, which extends for more than half the length of the dock along the eastern or harbor side and is returned around the entrance in about 30 ft. of water was successfully completed a few days ago and the water pumped out. The excavations, which are mostly in solid rock, are approaching completion and the masonry will shortly be commenced. The dock is to be built of Portland cement concrete, with granite copings to the altars, granite stairways and timber slides and a granite entrance closed by an iron caisson. The structure will be the largest of its kind in America and one of the largest in the world, the internal dimensions being, in the clear, 580 ft. in length, 102 ft. in width at top, across the body of the dock and 70 ft. on the bottom, with 30 ft. draft of water over sill at ordinary high water and 85 ft. width of entrance. It is designed to accommodate the largest British ironclad as well as the ordinary mercantile marine. The company which has undertaken its construction is to receive, after its completion, (which is limited to May 1, 1890) a subsidy of $30,000 per annum for 20 years, $10,000 being contributed by the British Government, $10,000 by the Dominion Government and $10,000 from the City of Halifax. The contractors are Messrs. S. PEARSON & SON, of Bradford, York, England, with whom is associated Mr. S. BROOKFIELD, of Halifax, who has the direct control of the work for the contractors. The engineer is Mr. J. F. LA TROBE BATEMAN, past President of the Institution of Civil Engineers, of London. The Resident Engineer is Mr. E. H. KEATING, of Halifax, who has recently been appointed to that position with the unanimous consent of the City Council, while at the same time he holds his former office of City Engineer.

THE true inwardness of the surveys which have been quietly in progress for a few months past in Massachusetts and Connecticut, is now revealed by maps and plans filed in the Register's office in this city for a railroad from New York to Boston. The line is to be built by the New York & Boston Rapid Transit Company, which includes four corporations formed to build different sections of the line. The plans are for a double track railway 193 miles in length, against 231 miles *via* Springfield, equipped with stone ballast, 81 pounds steel rails, and permanent bridges and culverts. There are to be no grade crossings and but two drawbridges, and the schedule time for express trains is to be three and one half hours. The total estimated cost of the line is $22,946,579, or $125,489 per mile. The New York station is to be at Eighth avenue and Fifty-ninth street. Thence the line runs north and crossing the Harlem and Bronx rivers reaches the Connecticut State line near Port Chester. From that point to New Haven, 43.4 miles, the line is to be built by the New York & Connecticut Air Line R. R. Co., which was chartered 1881. From New Haven to Boston the most direct route is taken. The officers of the company are WM. T. BLACK, President; D. C. LINDSLEY, Chief Engineer; THOS. F. BROWNE, Secretary; and CHITTENDEN, TOWNSEND & CHITTENDEN, Legal Counsel. It is a great project, and it is not impossible that such a line might prove a financial success. We have briefly considered that matter elsewhere.

THE Master Car Builders' Association have made the subject of Heating Cars a special subject for discussion on the morning of the third day of their convention at Minneapolis, Minn., which begins on Tuesday, June 14. It is to be hoped that their discussion will be more fruitful of results than has been their long-drawn-out action on the car-coupler question, and it is likely to be, for the car-heating question is practically already settled by events in favor of steam-heating from the locomotive, as it would not have been by a generation of discussion in that body. Some people will be burned up alive, of course, next winter, as there have been every winter, but there will not be so many, and the roads on which it occurs will find themselves in an attitude before the public which they will not at all enjoy, nor be likely to risk a repetition of.

THE Dominion Government has at last publicly declared that it will disallow the charters granted by the Manitoba legislature to connect with American lines, on the ground that "the present policy" of favoring exclusively Canadian connections "must be maintained at all hazards." A more hopeless and silly attempt to control and destroy the natural channels of trade has hardly been made in the nineteenth century. There can be but one end to it, complete and utter failure, with more or less injury to the industrial development of Canada in the meantime. The Dominion consists of four distinct groups of thinly populated regions, separated by wide stretches of almost completely barren and worthless lands; the coast provinces, the two chief Canada provinces, the Manitoba region, and the Pacific region. The natural trade relations of each one of these groups is with the contiguous states of the United States to the south, while they have little or no natural business relations with each other. To fight against the natural result of such conditions with so antiquated a weapon as a prohibition of the construction of ways of communication is a problem which would have commended itself strongly to statesmen of the fifteenth century, but hardly should to those of the nineteenth.

RUMORS from Panama, of May 16, speak of the tapping of a heavy stream of water far above the level of the Panama canal, which, says the report, has washed down earth enough to fill the cuts below and thus "render valueless work costing millions." Water is a very usual thing in a deep cut, but we hardly think the contractors have struck the subterranean flood required to do the damage represented.

THE Executive Committee of the International Exposition of Railway Appliances, of Paris, through Mr. JOHN W. WESTON, the Com. Gen. for the U. S., ask for the loan of any objects, books, medals, drawings, etc., relating to the history of railways and means of transportation generally. All such objects will be packed, shipped and returned at the expense of the Committee, and they will be insured for such values as the lender may put upon them. Address M. G. SENECHAL, 8 Faubourg Montmartre, Paris, or Geo. L. FOWLER, M. E., Commissioner for the U. S., Palais de l' Exposition, Bois de Vincennes, Paris.

THE McKeen, Perry, Marks, United States, Barnes, Browning, Dowling, Hein, Janney Titus, & Bossinger and Thurmond couplers have their cars already equipped for the coming competition, and the Gifford may also enter. It is not now likely that the preliminary tests will begin before June 6.

ON May 8 a party of about 50 men sailed from Antwerp in the interest of "The Congo Company," organized a few months ago to survey a route for a proposed railroad along the 235 miles of cataracts of the Congo river and to obtain full information as to the commercial possibilities of the upper Congo. The company is working under a concession from the Congo Free State granted to leading men of Belgium. The sum of $200,000 is to be expended in this preliminary investigation, which includes the traversing of some 5,000 miles of the waters above Stanley Pool by means of a steel steamboat carried out by the present party.

THE outline for the improved water-supply of Chicago, includes plans for a submerged crib 3 or 4 miles from shore and deep enough to allow the largest lake vessels to pass over it; an independent tunnel connecting the cribs with pumping works on the South Division, and the connections of these works with the present distribution. This plan presupposes the diversion of the flood-waters of the Desplaines river according to the plans already made by Mr. HERING. By placing the crib 30 ft. below the surface the sludge and other floating impurities will be avoided and anchor ice can not interfere with the water supply to the crib. It will be cheaper and cost less to maintain, as it will not be effected by storms or drift-ice. Chief Engineer ARTINGSTALL estimates the cost of these improvements at about $1,400,000.

WM. STARLING, Chief Engineer of the Mississippi Levee Commissioners, estimates as follows for the enlargement of old levees deemed advisable and for new work:—Enlargement above Greenville, 1,149,400 cu. yds.; below Greenville, 1,337,500 cu. yds.; new work, 764,000 cu. yds. The total is 2,101,500 cu. yds. costing about $400,000. The commissioners at their meeting of May 10 resolved that this work be done and to this end passed resolutions looking towards the negotiation of the necessary bonds.

THE construction of another Hudson river railroad tunnel, to be built by the Pennsylvania R. R., is denied by the officials of that company. The rumors can be traced to no authoritative source.

ALTHOUGH hardly in one sense "engineering news," yet it seems as if the fact ought to be noted even in these columns that we have this week paid off the last dollar of the war debt which we are at liberty to pay, and stand ready to pay more to any of our fast diminishing creditors who will take the money. This now happens for the third time in our history, and its significance as an indication of national power, stability and growth can hardly be exaggerated. Although it would hardly do to claim the credit for engineers, of such astounding financial strength, yet it may fairly be said to be for the same reason that we have so many and so good engineers in this country, and in that sense engineers as a class may take pride in it. This is the only nation which even attempts to pay its debts, and long may it wave—and its engineers likewise.

"PROPOSALS," (inquiries, we presume) were received last week from the Chilian government, by the Sewall Car Heating Company, of Augusta, Me., for the heating of all the railway passenger trains in that country by the Sewall patent. This is certainly a great card for the Sewall company as well as for the Chilian government, showing that spirit of progress for which Chili is famous among South American republics.

AN even half of a trestle, a mile and a half long, over the "Columbia slough" at Portland, Oregon, fell over like a row of bricks on May 22, but fortunately did no damage except to the reputation of the man who built it. Cause; complete absence of longitudinal bracing and a bad foundation to start the fall.

IT is a significant and somewhat amusing fact that the "sandy" Scotchman who is building the Thistle to compete for the America's cup, turns out to be practically an American, Mr. WM. CLARK, of Newark, the great thread manufacturer. Others are associated with him, but he seems to be the originator and chief backer of the enterprise. From the newspaper statements that Mr. CLARK is an active Republican, and has several times been urged to take office, we infer that he is an American in law as he seems to be in his enterprise, and should his yacht succeed in taking the cup, we shall not feel quite so badly as we otherwise might have done.

DURING the week washouts have occurred on the St. Johnsbury & Lake Champlain and the Atchison, Topeka & Santa Fé railroads; a train being wrecked by the former, and the latter extending for several miles in Colorado. A landslide on the Delaware & Hudson Railroad caused a wreck, and melting snow caused a cave in the Mullen tunnel on the Northern Pacific Railroad. Cyclones occurred near Nogales, Ariz., May 29, and near Sandusky, O., May 30. Earthquake shocks were felt at the City of Mexico, in Mexico, May 29, and at Nogales, Ariz., May 39.

THE most serious railroad accident of the week occurred May 27, on the Pennsylvania Railroad at the Horseshoe curve near Kittanning Point, Pa. The bursting of a wheel of a coal car in an east bound freight train, at just the right moment, caused the car to leave the track and crash into two cars of a passing west bound passenger train. Six persons were killed and eight injured. The Pennsylvania Railroad may be congratulated upon the fact that the recent accident, the most serious one for some time, belonged to a class whose prevention is almost beyond human foresight.

Traction Rope Railways.*

BY D. J. MILLER, MEMBER OF THE WESTERN SOCIETY OF ENGINEERS.

[Read March 1, 1887.]

In the fall of 1882, I had the pleasure of presenting to this Society a brief description of the Chicago cable roads, and in said description advocated the introduction of duplicate cables, considering duplication of the motive power of vital importance to the perfection of this system of traction. Since then I have been able to carry my theory into practice to a certain extent, and have had the satisfaction of demonstrating the feasibility of what was at that time an untried plan.

Four years ago there were, in the United States, 36¼ miles of cable road in operation and under construction. Jan. 1, 1887, there were 116 miles additional in operation and under construction, making a total of 152¼ miles, and from present indications it is fair to assume that at least 100 miles will be added to the above figure during the ensuing year.

While some of the later roads contain valuable improvements, there are others the designs and workmanship of which could not well be worse. Within the last year or two, many unscrupulous speculators have manifested a decided interest and activity in cable work, attempting, especially of late, to palm off on the public what they are pleased to designate as some particular system of cable traction, the so-called system in reality containing not one element requisite to a good road; but this method of propulsion has grown in popularity so rapidly that many capitalists willingly invest in cable roads regardless of their merits or demerits. We have known of millions being expended in constructing lines which, when finished, were inferior to animal traction, so far as service to the public was concerned, and from a financial standpoint also, the horse road would be preferable. Nevertheless we do not know of one in operation not paying a fair interest on the first cost.

Unless investors exercise extreme caution, and closely investigate before absolutely committing themselves to any plans or schemes submitted for approval, the increasing number of inferior roads, together with bad management in operation, will result in arousing general indignation, and public sentiment will eventually bear strongly against their further extension and greatly interfere with future progress in this direction.

A street railway, under the cable system, becomes a colossal machine, and its efficiency is unquestionable, provided the component parts are properly arranged and cared for, but with disinterested and careless or ignorant attendance, demoralization and destruction must surely follow in the course of events.

The serviceableness of a road, no matter how meritorious the system, can and will be materially affected by mismanagement, which fact cannot be too forcibly impressed on stockholders, as in this case it means smaller dividends and costly repairs.

We find records of patents, both foreign and American, long since expired, the drawings and specifications of which cover the same ground that inventors of later date have endeavored to secure by letters patent. For instance, in an English patent granted in 1845, a tube between the rails is illustrated with slot in center and a rope to draw the car. The gripper was provided with movable parts for grasping the cable, and had wheels intended to move on rails or guides in the conduit.

The principles demonstrated in the above-mentioned patent are carried out in the roads of to-day.

To show the development forty years ago in cable traction, we give a few extracts from a description of the London & Blackhall Railway, published in 1852, a copy of which was kindly furnished us by Gen. CHARLES FITZSIMMONS.

"A pair of powerful marine engines were erected at each end of the line, to which the drums for winding up the rope were connected by friction clutches. The drums were of cast iron, each 23 ft. in diameter, and their circumference revolved on an average of 26 miles per hour. The rope was 5¾-ins. in circumference and being upward of six miles in length, weighed about 40 tons, and was sufficiently long to reach from one end of the line to the other, when somewhat more than one-half the rope was wound upon one of the drums. The cable was supported along the line by cast-iron wheels or sheaves, 3 ft. in diameter and 7½-ins. in width, which not only prevented the rope from trailing upon the ground, but also guided it around the curved portions of the line. The carriages were connected to the rope in such a manner that they could be instantly released without stopping the motion of the rope, and again connected if required." In the foregoing we find the following points of interest: First, the cars could be detached from and again attached to the rope while the latter was in motion. Second, the cable moved at the rate of 26 miles per hour. Third, the winding drums were of sufficient capacity to store three miles of 1⅜-in. rope, weighing 20 tons. Fourth, these drums were connected to the engines by friction clutches.

As copies of foreign patents were not formerly filed in the United States Patent Office, it is probable that GARDNER was not cognizant of the existence of a similar English patent, when he obtained the American patent in 1858 on the conduit and slot for traction rope railways.

In 1869 a patent was issued to Gen. G. T. BEAUREGARD covering some minor details, but the drawing represented a grip having jaws that could close on a moving cable, and the friction caused by this contact would start the car as easily as might be desired. In this design, the cable was above the car.

GARDNER'S specifications refer to a grip (calling it a catch) connected to the car, projecting through the slot, and engaging with the cable in the conduit, and these inventions embodied the rudimental principles of the present system of traction rope railways. Forty-five patents on traction were issued in the United States prior to 1875. Of this number, four were granted to Mr. A. S. HALLIDIE of San Francisco, on running and carrying ropes, but were not applicable to the propulsion of street cars.

In 1872 Mr. HALLIDIE obtained his first patent on the grip, the drawings of which illustrated a vertical shank intended to extend from the floor of the car, through the slot and into the conduit, with wheels or jaws on the lower end for gripping the cable, but the principal points were not covered in the patent.

In constructing the first cable road, Clay street Hill, San Francisco, the Gardner tube, and above described principles of the Hallidie grip, together with the Beauregard grip jaw were adopted, with modifications and improvements.

The second road constructed was on Sutter street, San Francisco, and this differed somewhat in detail from the line on Clay street Hill. The general arrangement of the grip was considered so satisfac tory that it was afterward adopted on nearly every road in San Francisco, and this grip, with other improvements, was designed by Mr. ASA E. HOVEY, the engineer of the road, who has for the past six years been connected with the Chicago roads.

To San Francisco belongs the credit of operating the first street surface cable road; yet Philadelphia by the invention of Gardner, must be accredited with the tube or conduit. But beyond question the undertaking in Chicago was attended with the greatest risk, as it had always been supposed that such a road could not be successfully operated in a cold climate.

To Mr. HOLMES we must concede great foresight,

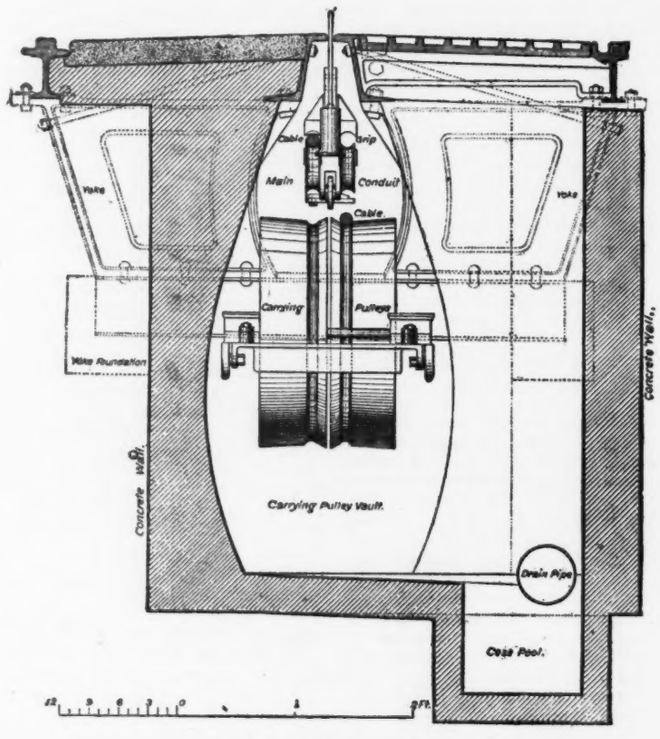


Fig. 1.—Traction Rope Railways.

and to him the cable road owes advancement and superiority of construction as well. When the Chicago roads were projected, there were but sixteen miles of cable road in operation in the world, and during the year 1881, the lines constructed in the above-mentioned city were on a larger scale, and more improved in detail, than anything of the kind previously built.

From the beginning the evolution has been gradual, until we now have a system destined, doubtless, to entirely supersede animal traction, wherever the traffic will guarantee the necessary outlay.

While single rope roads can be, and are operated successfully, they are nevertheless not entirely satisfactory, owing to the frequent stoppage for repairs, whereby the public is greatly discommoded, not to mention the money loss of the railroad company, and to overcome this acknowledged defect we have duplicated the motive power throughout. All machinery must be especially designed for its work, and no detail neglected, as the operating expense of motive power is governed almost entirely by its arrangement, as is also the continuous running of the cars.

Machinery and cables cannot give as good service in constant use as when the necessary time can be devoted to inspection and repairs; and on single rope roads, the two or three hours available in the morning are not sufficient to thoroughly inspect the

*From Journal of the Association of Engineering Societies; May, 1887.